PC MAGAZINE

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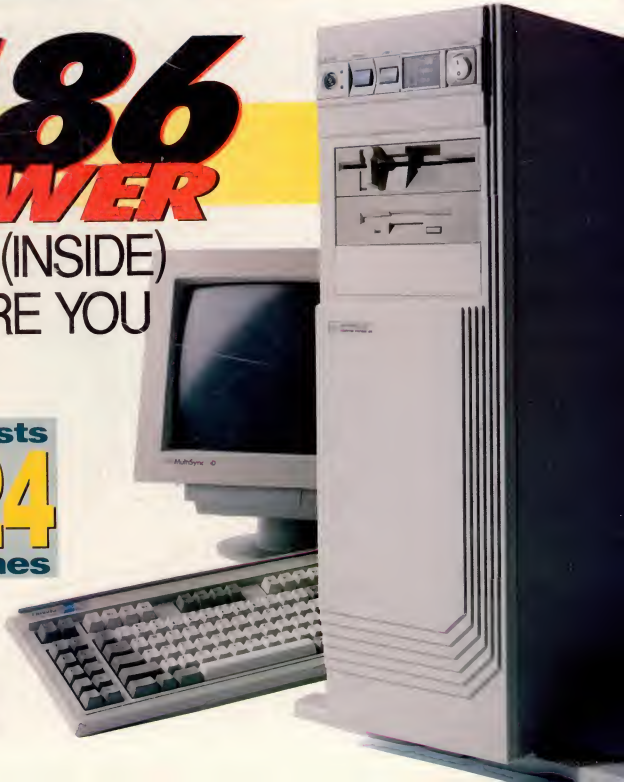
SEPTEMBER 11, 1990 THE INDEPENDENT GUIDE TO IBM-STANDARD PERSONAL COMPUTING VOLUME 9 NUMBER 15

486 POWER

LOOK (INSIDE) BEFORE YOU LEAP!



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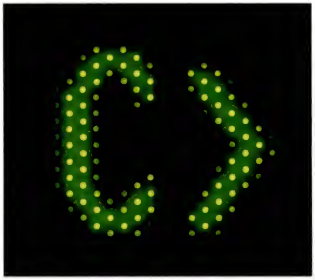

Introducing new Windows 3.0.

The graphical user interface (GUI) environment on an MS-DOS® PC, and subsequent demise of the "C" prompt, is a reality today. Sure, you say.

Microsoft realizes you may have heard this one before. And we agree that you have every reason to be skeptical.

Well, all of this was before new Microsoft® Windows™ version 3.0. A GUI environment that will forever transform the way you use your PC.

Now, before you wonder what to do with all of your existing DOS applications (to say nothing about your existing DOS experience), the Windows environment works within your MS-DOS system. This is not a traumatic thing.

As a matter of fact, once you see the environment created by Windows 3.0, you'll think quite the contrary.

The first time you see it, you won't believe it. Archaic characters, mundane instructions, and even entire command sequences, have been replaced by a program manager full of clear, friendly icons. You're immediately comfortable.

When you work on more than one thing at a time, you'll quickly reap the benefits. Because the program manager welcomes on-screen multitasking of large Windows applications. Of course, without ever visiting the "C" prompt.

Through something with the co plicated name of Dynamic Data Ex-

PHOTOGRAPH

change (DDE), you can simplify your life. For example, with DDE, you can change information in a Microsoft Excel spreadsheet, and have those changes automatically show up in a "linked" table in a word processing document. Or vice versa.

You can also easily access a network from within Windows. So, no matter how big the rivalry between research and accounting is on the softball field, everybody's on speaking terms in the office.

Even the setup program is graphical, only needing a few easy steps.

At this point, you probably think your machine will slow to a crawl the first time you try any of this.

We thought about that, too. So new Windows 3.0 breaks the 640K memory barrier that saddles other DOS programs. Giving you access to all the memory and power your 286 or 386 PC can muster.

It all sounds incredible. Which it is. And, it's taking place in an intuitive, consistent graphical environment.

For more information or to learn about upgrading your current Windows version, call (800) 323-3577, Dept. K85.

Graphics-based software is how people will run their PCs in the 1990s.

And there's no better way to get yourself acquainted than Windows 3.0.

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Microsoft Windows 3.0 is optimized for 1-2MB 286 and 386 personal computers, 640K RAM required. Customers inside the 50 United States, call (800) 323-3577, Dept. K85. In Canada, call (416) 673-7678. Outside the U.S. and Canada, call (206) 882-8661.
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CIRCLE 267 ON READER SERVICE CARD

Inside

Hundreds of writers and analysts cover the PC industry. Arguably, the most articulate, most highly regarded voice belongs to contributing editor Jim Seymour, author of the introduction to our comparative reviews of 80486-based PCs, "Muscle Machines: The First 24 486s."

Seymour writes columns for *PC Magazine* and its sister publications *PC/Computing* and *PC Week*. When he's not writing or speaking to industry trade groups, he's active as a strategic consultant to Fortune 500 companies, helping them determine what computers will be like five and ten years down the road and how they'll be used.

Contributing editor Jim Seymour: the industry's "most respected and widely read commentator," according to *The New York Times*.

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His secluded Texas home/office is a familiar stop for numerous software and hardware companies who want early feedback on how their products-in-development are likely to fare. The insights Seymour gathers from his multiple insider's perspectives and shares in his columns led *The New York Times* last year to proclaim him "the most respected and widely read commentator" on computers.

While other voices have been rather quick to applaud the first round of 486 systems, Seymour sounds a cautionary note. He wonders if the first 486 PCs—those based on the 25-MHz Intel part—won't become "footnotes to history" similar to the first 16-MHz 386s of 1986-87. He believes 33 MHz is where the 486 chip begins to get exciting; 50-MHz 486s, due early in 1991, will be the machines of choice among power users.

Seymour's computer-industry career stretches back to the early 1970s, as a consultant to businesses buying minicomputers. "I knew enough about what the computer companies were doing in the labs that I could sit through several sales pitches, and then when each group left the room, tell the buying committee who was lying, when, why, and how," he recalls.

Seymour's long career spans more than just computers. He's worked as a photographer and writer for *Life*, *Time*, *Newsweek*, *Paris-Match* and a dozen other magazines. He's a fanatical fly fisherman, a serious classical and jazz musician, and he's taught in the journalism and law schools of his alma mater, the University of Texas. He was also the founding editor-in-chief of *PC/Computing*, which went from a cold start to a half-million paid circulation in less than a year and was a National Magazine Awards nominee.

But nobody's perfect. Back in the 1970s, Seymour recalls, he almost bought, for personal use, a Digital PDP-8 minicomputer. "That would have been s-t-u-p-i-d," he says. "Fortunately, PCs came along just in time to save me."—**Bill Howard** ■

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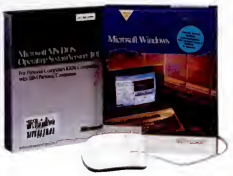

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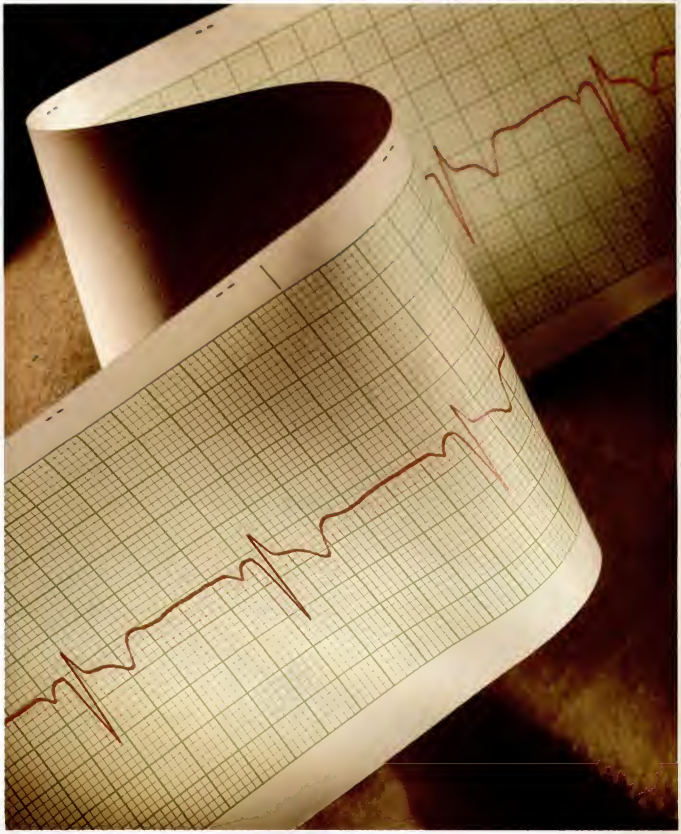

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Or load several sessions of the same program, each with a different file, pop back and forth, and work on several spreadsheets, documents, or anything else, all at once.

Why didn't someone do this before?

Actually, a lot of people tried. But what they ended with were a bunch of fancy software "environments" that eat up memory, change the way you work, and boggle the mind with complexity.

Plus, a lot of them make you buy new "compatible" software applications. Some even make you buy a bigger computer.

Software Carousel, on the other hand, works with the programs you already own. So you can go on using 1-2-3, WordPerfect, dBASE, SideKick, any program that runs on the computer you use right now. In an absolute minimum of memory. Without changing anything about the way your software runs.

Best of all, Software Carousel makes the most of your computer's memory by letting you use all available lower RAM in each program you use. And if you decide to add extended or expanded memory, Software Carousel works with that too, and makes switching even faster.

Garry Ray, writing for PC Week said, "Of these three alternative operating environments (OS/2, Desqview and Software Carousel), Carousel may be the best choice of the day."

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#6

Letters

LANS VS. MINIS: ROUND TWO

As an AS/400 and PC user, I found your story: "Can LANs Beat Minis?" (*PC Magazine,* May 29, 1990) lacking credibility because you didn't test an IBM solution. IBM's AS/400 was mentioned in the article, but it was not used in testing. How can you test "minis" and leave it out?

Despite its not being used by your lab, in the real world the AS/400 would beat the pants off of a LAN solution for relational databases with multiple access paths; the superior operating system (OS/400); and its unique architecture which allows any number of users to share pages of programs already in memory, resulting in a lot of usage with zero disk accesses.

I'll take the AS/400, and use PCs as attached workstations.

Stanley Kritzik
Milwaukee, Wisconsin

Our performance tests were based on an accounting scenario. By testing DEC MicroVAXes (which are widely used for large-scale accounting applications and which are far more prevalent than AS/400s) we were able to run the same accounting package, *RealWorld*, on all the platforms we tested.—*Ed.*

What would be really interesting would be for *PC Magazine* to allow six industry experts to design their ultimate multiworkstation system, three LAN and three Unix/Xenix. Give them a fixed budget and a set number of workstations, then put each of the systems to the test and see what happens.

Mike Peterson
Turlock, California

Most of us in the real world are not interested in performance graphs of 100 effective stations. I would guess that most companies have systems with 30 stations or less. The mixed processing graph shows Unix performance about a third slower than LANs with 100 effective users. I would imagine that a chart of 20 or 30 users would show only a small performance difference.

Minicomputer and Unix fans speak out in favor of their multiuser systems.

I considered this article very helpful. Had you presented performance charts and conclusions for the under-30 workstations group, it would have been excellent.

Jim Mecom
Ennis, Texas

OPENING WINDOWS

Many thanks to *PC Magazine* for the new *Windows* column. I am a *Windows* consultant and will certainly look forward to the *Windows* articles in each issue.

OS/2 and PM are here to stay, but I would be on welfare if I were making my living on PM. While OS/2 and PM articles abound in the industry journals, I wonder if anybody actually reads them! Never have I seen so much written about so little for so few. In particular, all of us in the *Windows* development community suffered a great loss when Charles Petzold decided to write exclusively about OS/2. We all hope he will take the time to upgrade his near legendary work "Programming Windows" for the 3.0 release.

Jim Barrett
Gillette, New Jersey

Why don't you rename the *Windows* column "Multitasking" and include Quarterdeck programs. None of your other columns devote themselves to just one company's product.

Philip S. Dunning
New York, New York

MONITORING 1024 MONITORS

I appreciate your review of 1024 monitors and graphic cards in your April 10, 1990, issue of *PC Magazine*. However, besides quality, performance, compatibility, and price, I would like to see the monitors tested and evaluated for their safety. I am very concerned about sitting only a few inches away from a 19-inch color monitor all day. As a user, what do I need to be aware of when purchasing a large monitor with safety in mind?

David K. Watase
Honolulu, Hawaii

Winn L. Rosch explored safety in the workplace in the December 12, 1989, Lab Notes, "The Big Question: Is the PC Environment a Safe Place to Work?" Besides citing from several studies concerning emissions from cathode ray tubes, Rosch, PC Labs, and an independent health physicist tested radiation from PCs and monitors to determine the safety of the PC environment.—*Ed.*

WORDPERFECT FOR TOUCH TYPERS

Daryl Close was right (Letters, May 15, 1990). *WordStar* is the only major word processor that supports touch typing. However, *WordPerfect* can be reconfigured to provide such support.

We have recently released *MorePerfect*, a *WordPerfect* add-on that moves edit commands onto the letter keys—but in a pattern much simpler, safer, and easier to learn than *WordStar*'s jumble. It also provides important commands missing from both *WordStar* and *WordPerfect*.

Mark Shepard
Arcata, California

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Letters

MorePerfect can be found in CompuServe's WordPerfect Support Group Forum A, Library 1, file MP.ZIP, or from simple productions, Arcata, Calif. (707) 822-3148.—*Ed.*

AN OLD FRIEND IN MEMORY

Barry Simon's piece on using High DOS brought back many memories of reconfiguring my machine to maximize the amount of contiguous memory (Lab Notes, *PC Magazine*, May 29, 1990). Not fond memories, mind you, but well worth the effort. Simon noted that some programs, notably *SideKick*, can fit in High DOS but cannot be loaded there. He should have mentioned the wonderful SWAPSK shareware utilities available on CompuServe and many other bulletin boards.

Sophisticated users demand more than HP's monospaced Courier font.

SWAPSK has you load *SideKick* into base 640 and then swaps it out to extended memory or even to disk. Best of all, SWAPSK is well behaved and can itself be loaded into High DOS. After having given up *SideKick* a few years back when I simply wasn't willing to part with the memory, I now welcome back an old friend, courtesy of the great folks who put out SWAPSK —Innovative Data Concepts.

Carlos Bonilla
Chevy Chase, Maryland

I agree that readers should know about the SWAP Utilities from Innovative Data Concepts, 3084 Woodlawn Ave., Glenside, PA 19038; (215) 884-3373. There are programs for swapping other large-memory TSRs, like *GOfer* and *PCTools*, as well as *SideKick* and *SideKick Plus.*—*Barry Simon*

A DIFFERENT VIEWPOINT

Both John C. Dvorak and Jim Seymour in the June 12, 1990, issue bemoan what I call the MicroPro/Editor's Choice lesson. MicroPro ceased to issue regular upgrades and lost its lock on the market. A number of programs have kept their features and coding sizes small and have been killed in the Editor's Choice comparisons. And every word processor I've seen that kept its code size small has kept its market share even smaller.

The industry isn't stupid. Programming is going along fine.

Stephen Marsh
Wichita Falls, Texas

A NUMBER FOR EVERY PAGE

Hey, I like *PC Magazine*, but do you realize that in the May 29, 1990, issue there are only 218 pages out of a total 494 pages that have page numbers on them? That is only 44 percent of the magazine.

Back in Gutenberg's time, they discovered that it was a big help to readers to have pages numbered.

Geoffrey Orton
Altamont, New York

PCL EMULATION: WHO CARES!

I feel I must comment on your cover story of June 12, 1990—laser printers. In order for a new laser to compete, it must be able to offer something more than 10- and 12-point Courier type.

The Canon LBP-4 uses the same engine as the LaserJet IIP, but it has scalable fonts. I appreciate that the Canon does not emulate Hewlett-Packard's PCL language, but who cares. Users of the HP will either be using programs that print in text mode or in a graphics mode that the Canon supports.

Most users given a choice and a similar price would rather have the font capability of the Canon over the HP emulation you deem so important. Users and software are more sophisticated in the nineties, and they demand something more than HP's primitive monospaced Courier font.

Rick De Coyte
Philadelphia, Pennsylvania

IBM'S PERSONAL TOUCH

My primary area of expertise is IBM mainframe systems, so I was glad to see the announcement in your magazine of the release of *Lotus 1-2-3M* (New & Improved, *PC Magazine*, May 15, 1990).

Since IBM is a multibillion dollar company, I thought it would have someone there to at least take my name and address on a Saturday morning. I called the toll-free number and after being voice-

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Why buy a laptop computer if you can't carry it with you? You wouldn't buy a portable radio without a battery, so why settle for a portable computer without the most essential element of portability. And why sacrifice the honest-to-goodness 32-bit speed of a genuine 386 (as opposed to the 32-bit emulation employed by an SX machine). Now you don't have to! DATAWORLD introduces a bona fide 20Mhz 386 laptop with the battery built right in.

In addition to all of the standard features offered by the competition, the LP320 has an LCD/VGA screen, which displays in "paper-white" clarity and requires very little power to operate. Also, an advanced sleep mode feature prolongs the usable battery time per charge by letting the display, hard drive, and CPU hibernate when not active. That's better by far than the competition's touted perfect portable!

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- VGA gas plasma display (640 × 480) with 16 gray scales
- 80386-25 processor
- 1MB RAM standard, expandable to 8MB
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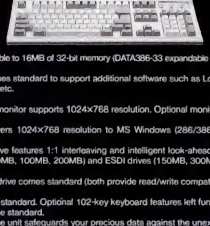

DATA386SX Super VGA slim-line $1995

(not pictured)

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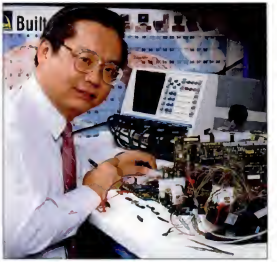
Servers move a tremendous amount of data in and out of memory and between memory and mass storage. Consequently, high performance servers, like our new 80386 33 MHz and 80486 models have to handle data transfer efficiently to achieve high throughput and more importantly, processing stability. That is, the ability to achieve a consistent and stable processing rate, unaffected by DMA, network I/O, or simultaneous network applications running full force.

To achieve our goal of efficient, high speed, mass data transfer, we took memory management seriously. The design of our new Arche ProFile™ and Legacy™ 80386 33 MHz and 80486 models utilize a mainframe memory management architecture based on our exclusive ProCache™ intelligent controller. Technologically, these advancements to the conventional PC memory subsystem provide a dramatic improvement in processing reliability, and increased throughput due to a substantial reduction in microprocessor interrupts.

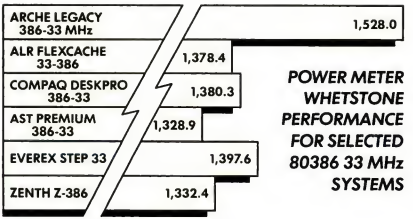
Pro-Cache optimizes memory management and minimizes microprocessor interrupts by acting as an intelligent liaison between the host CPU, its cache, main memory and DMA devices, like hard drives, floppies and tape back up, across an entire network. Given proprietary ARCHE algorithms, ProCache can govern tasks related to host and network data management previously the responsibility of the host CPU. This frees the CPU to do its primary job; data processing, leaving ProCache to handle memory management and DMA.

Using a technique called "flagged register copy back," ProCache can "snoop" between cache and main memory to determine the level of data concurrency. Unlike a write-through cache, used in most conventional PC memory subsystems, ProCache will only write data into main memory when required. In order to further improve performance, write-back on a cache miss is buffered. Thus, a miss will not interfere with a fetch cycle and will not stop the microprocessor from processing.

"With ProCache," network users no longer need to suffer from degradation of server performance associated with DMA, network I/O, or simultaneous applications running full force."
Joe Kua



Accordingly with ProCache, network users no longer need to suffer from degradation of system performance associated with host memory management conflicts. These conflicts are typical of any computer using a conventional memory subsystem, such as one based on Intel's 82385 write through cache controller. That's because systems using an 82385 actually force DMA to fight with the host CPU for access to memory. And, this is inherent in 82385 design as



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Advertisement

Continued from opposite page

the CPU is forced to write through to main memory on every cache hit.

Consequently, an 82385 or similar write-through design, makes DMA devices, in the host or throughout a network, wait in line to access main memory. And, when they do get through, the host CPU has to stop and wait for DMA to complete. With this architecture, the greater the hit rate and number of DMA devices, the slower the system and ultimately, in the case of a server, the entire network.

ProCache™ can predict and prevent a cache miss before it occurs

With ProCache, however, the host CPU doesn't stop during DMA. And, this allowed ARCHE to implement some truly amazing functions into a system based on the PC platform. With ProCache, our designs take advantage of transparent DMA and truly intelligent snooping. This enables ProCache to turn mastermode executives on and off without stopping the CPU and the ability to snoop on memory in order to predict and prevent a cache miss before it occurs.

The results of our effort and the benefit to every computer user is now known. Running Novell 386 and DOS for example, our ProFile 386-33 delivers an unsurpassed level of processing stability; running 36 simultaneous sessions at 8.3 MIPS and 1,528 Kilowhetstones. We consider this technology well implemented, an essential factor when your quest is to provide Quality Above All.

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Letters

mailed I was informed that the office was closed and that I could call back during business hours. I could not even leave a message for someone to call me back. I called several other vendors of software that morning and *all* of them had someone

I called the toll-free number on Saturday morning and was voice-mailed.

there to take information and send out literature. It is no wonder IBM is losing its market share.

Kriss Davis
Champaign, Illinois

THREE CHEERS FOR KEYB LA

The Tutor and The Working Word articles in the May 15, 1990, issue that deal with entering French language characters involve methods that are unnecessarily complicated. Most dot matrix printers and all laser printers can handle any of the extended ASCII foreign language characters—which include French accented characters. Input presents a problem, not output.

Of the differing methods for adding accents, the most versatile one that retains our key arrangement is KEYB LA. It has all the accents required to write in French, Spanish, and Italian.

The DOS command to invoke KEYB LA is simply to type KEYB LA from the same directory as KEYBOARD.SYS. That's all. There's seldom a need to make any change in the default country code or the default code page. Most of us can overlook entirely the complications of code page switching.

Howard Rogers
San Diego, California

It's always nice to find oneself one up on the experts. Type KEYB LA, and you will have everything you ever wanted for word processing in French. It has to be entered ahead of any application, however, as it is a DOS memory resident program similar to PROMPT.

Marie Chlad
La Jolla, California

If Jeff Prosise and Craig Stark had learned how easy it is to type in French using KEYB LA, the Canadians featured in their columns would be everlastingly grateful.

Please give all of your readers a break—especially the Canadians—and tell them about KEYB LA.

Kristen Ray
San Diego, California

PC MAGAZINE The KEYB LA command can provide a quick solution to this problem; however, it is not universally supported and certain configurations may require users to change settings such as their PC's code page. Check your DOS manual.—*Ed.*

MORE ACCURATE FOR ACCURET

Lee Thé's "Price Waterhouse Report: Economy Class Accounting" in the April 10, 1990, issue was an excellent overview for business buyers.

Mr. Thé referred to Accuret, an inexpensive check reconciliation service, developed by Intuit and sold by banks. The article mentioned that the First Interstate Bank of California offers Accuret. The service is also available through Citibank, Illinois; Sun Bank, Florida; South Carolina National, South Carolina; Bank One, Ohio; as well as the First Interstate Bank of Texas, Washington, and Alaska.

Scott Cook
President
Intuit Inc.
Menlo Park, California

CORRECTIONS & AMPLIFICATIONS

The new price for Hewlett-Packard's LANProbe is $4,995, reduced from $8,000 ("LAN Troubleshooters: Protocol Analyzers and Traffic Counters," *PC Magazine*, June 26, 1990).

HOW TO WRITE TO PC MAGAZINE

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200 MB	3098	3218	3485	3538	4615
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200 MB	2108	2228	2495	2548

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Cure For The Common Clone

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Bricks are available with a 16 or 20 MHz 386sx; a 387sx coprocessor; 1 to 8 MB RAM; and your choice of a 40 (25ms), 100 (25ms), or 200 MB (16ms) hard disk. Bricks also deliver superb VGA graphics with 1MB video RAM supporting 800 x 600 and 1024 x 768 resolution for CAD, DTP or Windows. As an added benefit, the Brick is very quiet. Its rugged aluminum case serves as a heat sink so the whisper fan rarely runs.

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The Brick provides another welcome bonus: an extra 192k of memory above the DOS 640k limit. This unique feature allows you to load resident programs, such as a network or TSRs, into a contiguous 192k block of

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The Brick
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high memory, and still leave the lower 640k free. The regular Brick shown above also accepts an internal ISA 16-bit half length card, while the "Stretch Brick," shown at right, accepts one full and one half length card.

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by
Lori Grunin

Advisor

APPLYING THE THUMBSCREWS

I am constantly removing the cover on my computer's case for access to switches, jumpers, etc., and have had to remove the cover screws with a screwdriver. Do you know of a source for thumbscrews of the size necessary to hold the cover on a typical PC clone case?

Jim Tropauer
Phoenix, Arizona

Thousands of other users—myself included—sympathize with your plight. In addition to being a pain to unscrew, those confounded critters get lost among the other detritus of office life.

When I faced the "screw" problem with my old AT, I discovered Curtis Manufacturing's Computer Speed Screws ($5.95 per package of 20; 30 Fitzgerald Dr., Jaffrey, NH 03452; (800) 548-4900, (603) 532-4123), black-and-white plastic thumbscrews that are much easier to remove and keep track of than their metal counterparts. You can pick them up in many retail stores, such as Egghead Discount Software. I used them heavily for about a year, and saw no tangible deterioration in the threads.

ON OR OFF?

I hear conflicting things about whether my PC should be left on or off when not in use. Some say that it should be left on, to prevent "chip creep" and other damaging effects of thermal expansion and contraction. Others say it should be left off, to save wear on the hard disk motor and bearings, and to minimize the dust and other foreign matter sucked in through the ventilation system. Who's right?

Vernon Shetley
Wellesley, Massachusetts

I'd sure love to be able to give you a definitive answer such as "always turn it off when the moon is full and the tides are high but leave it on if the azaleas are in bloom or if the ground hog saw his shadow on February 2," but unfortunately, the answer isn't quite that cut and dried—the heated debates that periodically pop up on on-line services attest to the disagreements that exist. The answer really depends on your frequency and pattern of usage and your operating environment. I can, however, try to clarify the issues and provide some common rules of thumb.

- **APPLYING THE THUMBSCREWS: Screwdriver-less screws for the oft-opened PC.**
- **ON OR OFF?: Is it bad to leave your machine running?**
- **CTRL-CAPS SWAP: Switching the awkward key placement.**

I'll start with the punchline: there seems to be a consensus (ie. grudging agreement) that you might as well turn your system off at the end of the day.

Now I'll use the rest of this space to qualify that answer.

I spoke with various computer, hard disk drive, and peripherals vendors, and they all agreed on one thing—frequent power cycling is bad for most components. The main system has three components of concern: the power supply, the motherboard, and the hard drive. The power supply is most vulnerable at start-up, when a spike of electricity runs through it; think of a light bulb filament which usually burns out when you flip the switch. In contrast, the unit is designed to withstand the heat generated by constant use.

The metal components of a motherboard, for instance the pins used as contacts for the integrated circuits that serve as RAM and ROM, will expand slightly at power-up and contract slightly as the system cools down. If these components are in sockets, the chips may gradually work their way loose over time; hence the name "chip creep." This was more of a problem with older machines, since today's systems tend to use SIMMs instead of DIPs. While this might be a problem, if your chips do start walking, they are easily pressed back into place. When a motherboard is manufactured, it goes through a burn-in in which it is subjected to heat much higher than it will ever attain while sitting on your desk.

The hard drive indisputably suffers more upon power-up and power-down than under constant use. When operating, the platters are constantly spinning, with a bit of friction on the spindle and the bearings. But the friction is minor compared to the expansion and contraction of the drive components. Some new hard drives have sophisticated positioners that allow them to automatically compensate for this thermally induced movement, which can cause the low-level formatting information to become unlocatable, but most drives will just give assorted errors upon boot-up.

One further note on hard drive use. When you first turn your system on, let it run for a while before you use the drive, especially in cold environments. Just as a car engine needs to warm up on cold winter days, a hard drive needs about 15 minutes to attain operating temperature. If you make sure that the drive is always at operating temperature before you use it, you minimize the risk of a mismatch between the head positioner and the low-level format information.

For most people, the hard drive is the most important concern—you can replace a power supply and a motherboard, but it's pretty tough to replace your files (especially if you're a lax backup-er). So you might want to give hard drive problems more weight when pondering the various scenarios.

The off-once-a-day-keeps technicians-away rule applies especially if you live or

work in an area subject to frequent brown- or blackouts, experience violent thunderstorms, or simply have flaky power; in this environment you want to minimize your system's power-on vulnerability. It might also be worth it to buy a minivacuum (available from most office supply or computer accessory catalogs) and periodically clean the particulate garbage out of the inside of your machine.

More qualifications: I haven't said that it's better to turn off your system once a day, just that it's okay to do it. For every manufacturer who claims that once-a-day power-off will increase the life of a system, another claims that it won't. Similarly, anecdotal evidence supports both sides; you'll hear about just as many systems that survived daily power-offs as about those that have been constantly running since they were first taken out of the box.

While anecdotal evidence isn't a terribly scientific way to approach this question, it's extremely difficult to perform an empirical study of the issue. The market is still relatively young, and it is impossible to ascertain whether a part has failed because of something that you have done or simply because its number was up; Mean Time Between Failure ratings are *averages* and *estimates*, not guarantees.

CTRL-CAPS SWAP

I need to replace my system with a faster machine. However, it seems that all the new desktop machines have placed the Caps Lock key immediately to the left of the A key, and the Ctrl key below the Shift key on the left and right. Can I take a new keyboard and somehow change the function of the Caps Lock key? Can I change the Caps Lock key into the Ctrl key and vice versa?

Larry W. Cracraft
Wichita, Kansas

If you want to retain the keyboard that comes with your new machine, you have your choice of free utilities that are available in the General Hardware Library of the IBMHW Forum on CompuServe (filenames FIX101.ARC, KEYCTL.ZIP) and PC MagNet (CTRLCAP.COM, IBM-FIX .COM). Obviously, you won't find yourself alone.

If you'd prefer a commercially available utility, *Fansi-Console* ($120; Hersey Micro Consulting Inc., P.O. Box 8276, Ann Arbor, MI 48107; (313) 994-3259) will let you remap the keyboard as well as provide some additional keyboard and screen utilities.

Lastly, if you decide you're not too fond of your new keyboard for reasons other than just layout, you might be able to find a new one more to your liking. Several keyboards available allow you to decide the placement of these two keys—for more information on various keyboards, see "Wanted: More than Just a Replacement" in the December 12, 1989, issue of *PC Magazine*.

ASK THE ADVISOR

Send your questions to Advisor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload to PC MagNet (see "By Modem" sidebar in the Utilities column for access information). Please specify your equipment. Unfortunately, personal replies are not possible. ■

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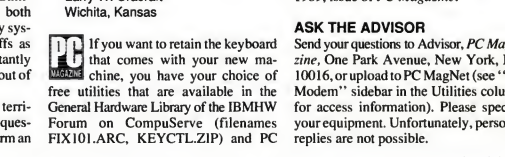

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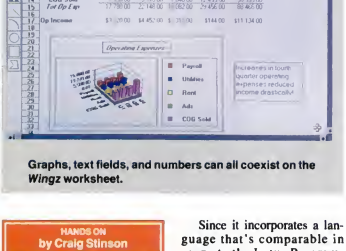
CIRCLE 165 ON READER SERVICE CARD

First Looks

Hands-on Reviews of the Latest Products

Wingz: It'll Graph But Will It Fly?



Graphs, text fields, and numbers can all coexist on the *Wingz* worksheet.

HANDS ON
by Craig Stinson

At first encounter, *Wingz* makes you think in superlatives. Surely this new Macintosh spreadsheet that Informix Software just introduced to the *Windows* and OS/2 markets is the most graphical of all spreadsheets! It does gorgeous charts in myriad types, with or without 3-D perspective, and with apparently unlimited customizability.

The $499 package treats the entire worksheet as a drawing board, allowing you to mix graphs, drawings, imported pictures, entire text documents, and even user-defined command buttons with traditional tabular matter. A mere click and a drag lets you set these display objects anywhere you please, including right on top of your numbers, or even on top of one another.

Since it incorporates a language that's comparable in scope to the Lotus Programming Language (the nucleus of the toolkit used for developing add-ins for *1-2-3*, Release 3), *Wingz* probably qualifies as the most programmable of spreadsheets. This HyperScript language comes with a compiler (but no debugger) and a comprehensive manual. And with a "wingz-span" of 32,768 columns by 32,768 rows, the program also takes honors as the largest spreadsheet known to mankind—for what that's worth. You can't come close to filling the cells without running out of memory.

This $499 package also earns a negative superlative—it's the least compatible of the major spreadsheet programs, despite its ability to import .WKS and .WK1 (not .WK3, .WR1, or .WG1) files. Like *Excel*, *Wingz* cut its teeth in a market where *Lotus* compatibility was not an issue. But unlike Microsoft, Informix has made minimal effort to recognize Lotus' de facto standard. Instead they chose to strive for complete file, command, mouse, script, and even documentation compatibility across all platforms. (The one major change that Informix made in moving *Wingz* to *Windows* and Presentation Manager was to include support for Dynamic Data Exchange.)

The most serious consequence of this cross-platform strategy is that HyperScript, while admirable on its own terms, is an island of incompatibility with no bridge to the mainland. You can bring *1-2-3* worksheets to *Wingz*, but you leave your macros behind. A less consequential problem for

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Three Utilities That Improve Windows

HANDS ON
by Barry Simon

The honeymoon between *Windows* and its users is over. While there's no question that Version 3.0 has greatly improved its program launching, there's still room for refinement.

One problem, particularly serious for network users, is that Program Manager insists that the application directory also be the default directory when the application starts. And whenever you resize a window, Program Manager finds an excuse to rearrange the icons, forcing you to play hide and seek. The real estate occupied by icons makes it difficult to place many choices in a window and you are also limited to having single items within a group, rather than subgroups.

Luckily, three new utilities take over where *Windows* left off. Wilson WindowWare's $49.95 *Command Post* 7.0 replaces the icon desktop with a functional, no-icons interface. For $99.95, hDC Computer Corp.'s *Windows Express* provides a smooth menu-oriented interface, while the $199.95 *CBM Desktop Office* from Publishing Technologies extends the icon metaphor. (Outside the U.S., *CBM Desktop Office* is sold as *Pubtech File Organizer*. A product by that name is also sold via some retail channels within the U.S., but it is only a subset of *CBM Desktop Office*).

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Wingz

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potential converts is that none of the customary function-key assignments (other than the SAA-decreed F1 for help and F10 for menu access) are enacted. If you like pressing F2 to edit a cell or F5 to go somewhere, *Wingz* will frustrate you.

Those emigrating from other MS-DOS spreadsheet programs will likely miss some other amenities they've long taken for granted. For example, there's no way to set a global display format in *Wingz*. If a fixed-decimal display with two points of precision doesn't suit you, you'll need to adjust your ranges individually. For that matter, unless you want to write a startup script (an autoexecuting HyperScript program), you can't permanently modify any of *Wingz*' defaults.

If you're accustomed to using simple macros to automate such routine chores as expanding ranges or summing columns, you're likely to find *Wingz*' HyperScript recording facility a disappointment. It insists on translating all cell-pointer and mouse movements into fixed addresses, instead of recording relative movement. An attempt to record the summation of a column, for example, will be translated into a statement such as "Put "=SUM(A1..A5)" into A6" instead of the HyperScript equivalent of "add up everything from here to there." A HyperScript formulation for the latter is available—but you'll need to browse the heavy manual to discover it.

There are other places where *Wingz* seems either unnecessarily rigid or strangely ill-designed. Like *Excel*, *Wingz* allows you to delete or insert partial rows or columns, or even single cells. But, unlike *Excel*, *Wingz* gives you no choice about which part of the worksheet moves in response to an insertion or deletion. Worse, the program treats relocated cells as though they'd been copied, rather than moved, adjusting all relative formula references in the process. Fortunately, an excellent Undo helps recover from such potential disasters.

Wingz can link files, but the targets of external-reference formulas must be in open worksheets, and the formulas themselves must be recalculated manually. Moreover, *Wingz* requires you to type in the external worksheet's name by hand—all the way down to the .WKZ extension—a peculiar limitation in a program that's otherwise so mouse-oriented. A separate product (*Wingz*-DataLink) gives *Wingz* users access to *Informix-SQL*, but Informix provides no other database outreach—not even to .DBF files.

Setting up a graph in *Wingz* is a breeze. You just select the block of cells you want to graph, click on the graph icon which is located on a palette that runs down the left side of the window, scroll to wherever you want to plant the graph, and drag the mouse to create a rectangle. As soon as you release the button, your chart appears, complete with legend. Unfortunately, if your data consists of a column of labels next to a column of numbers, *Wingz* parses the data into that many separate series, each consisting of a single point. A menu command parses the data the other way, but a program as feature-rich as *Wingz* shouldn't make so much trouble for the user.

Wingz is best suited for those with specific presentation needs. Unlike both *Excel* and *1-2-3/G*, which create their graphs in separate windows, *Wingz* packs everything onto a

PERFORMANCE TESTS: WINGZ

On both OS/2 and *Microsoft Windows*, *Wingz* turns in good (but not great) performance; *Microsoft Excel* remains the fastest GUI-based spreadsheet around. But *Wingz* creates the smallest files, which are quickly loaded and saved.

The **Mathematical Worksheet Recalculation** test measures the time a program takes to calculate a worksheet containing 1,456 mathematical functions (square root, addition, subtraction, multiplication, division, and @SUM).

The **Loan Recalculation** test calculates the monthly payment and displays the amortization schedule for a 30-year mortgage with a given loan principal. All columns columns except the payment and month number require recalculation.

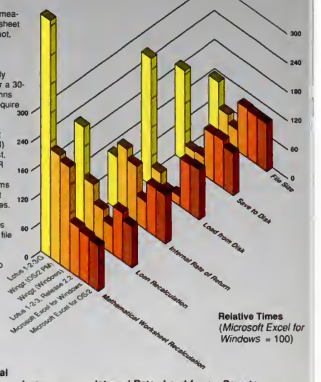
The **Internal Rate of Return** test calculates the net present value (NPV) and internal rate of return (IRR) for 253 different ten-year cash flows. During the test, NPV figures remain constant, but we forced the IRR function into recalculation by changing the iteration guess factor. Programs that use intelligent algorithms will recognize this distinction, while those that don't must recalculate the NPV figures, slowing their times.

The **Load from Disk** test measures the time it takes to load the Mathematical Worksheet Recalculation file from disk in the program's native file format.

The **Save to Disk** test measures the time it takes to write the same test file to disk in the program's native file format.

File Size reports the size of the Mathematical Worksheet Recalculation file written to disk in each program's native file format.

All tests were performed on a Compaq Deskpro 386/25 with 4MB RAM and an 80387 coprocessor.



Performance Times (Times given in seconds; file size given in kilobytes)	Mathematical Worksheet Recalculation	Loan Recalculation	Internal Rate of Return	Load from Disk	Save to Disk	File Size
Lotus 1-2-3/G	64.81	2.39	1.10	20.92	6.15	90.88
Wingz (OS/2 PM)	29.73	1.26	1.42	3.17	1.13	48.08
Wingz (Windows)	28.47	0.85	1.20	1.01	1.22	34.08
Lotus 1-2-3, Release 2.2	13.77	0.62	0.59	1.52	3.21	80.62
Microsoft Excel for Windows	13.17	1.08	1.02	7.92	3.28	78.76
Microsoft Excel for OS/2	12.62	0.93	1.02	8.19	2.90	78.76

FACT FILE

***Wingz* 1.1**
Informix Software Inc., 4100 Bohannon Dr., Menlo Park, CA 94025; (415) 926-6300.
List Price: $499 (includes both *Windows* and OS/2 versions in one box).
Requires: *Windows* 3.0, OS/2 1.1, or OS/2 1.2, and a mouse.
In Short: This, the most graphical of spreadsheets, is available in identical versions for the Macintosh, *Windows* 3.0, and Presentation Manager. While it's rich with presentation and application-development features, it's short on spreadsheet amenities; its macro recorder is poorly suited to everyday tasks. The programming language is incompatible with those of *Lotus 1-2-3* and *Microsoft Excel*.

CIRCLE 438 ON READER SERVICE CARD

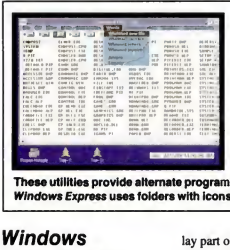
First Looks

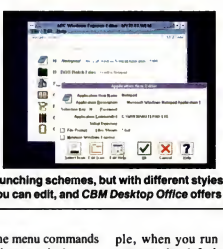
CONTINUED FROM PAGE 34

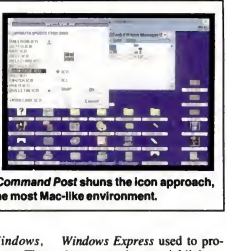
single sheet making it ideal for creating compound documents. You can add extensive annotations by opening text fields on any worksheet. A text field acts like a miniature word processor with features that include word wrap, tabs and line spacing. Both the screen and paper can have scaling factors (25 to 400 percent) applied to a worksheet. Any font and point size available in your graphic environment is available for any element of the worksheet. Cells and ranges can have borders created with lines available in many weights; color can be assigned to various worksheet elements. If you don't like the standard color offerings, you can use *Wingz*' RGB sliders to define your own.

Wingz' charting options are unparalleled. In addition to the usual, *Wingz* supports polar, contour, surface, and wireframe charts. Three-dimensional perspective is available, and you can even adjust the elevation and rotation of 3-D charts. Application developers will appreciate the ability to create custom menus, dialog boxes, and command buttons, as well the option to suppress any aspect of the normal worksheet display.

There's an awful lot to like about *Wingz*. Unfortunately, it comes up short in the place that matters most to most users—in the services it provides for routine spreadsheet work. ■







These utilities provide alternate program-launching schemes, but with different styles. *Command Post* shuns the icon approach, *Windows Express* uses folders with icons you can edit, and *CBM Desktop Office* offers the most Mac-like environment.

Windows

CONTINUED FROM PAGE 33

All of these programs offer their own version of Program Manager. *Command Post* and *CBM Desktop* also replace File Manager. Stylistic differences among this trio of utilities are so great that they, rather than the functional differences, will likely dictate your choice.

Command Post is for those who say "icon-shmicon." It uses a pure menu-driven interface, sans icons. The look is a throwback to the MS-DOS executive but with some significant enhancements. For instance, you can open a second window and windows for one or more directory trees, and then control source and destination for copies and moves.

Some will miss the simplicity of the old *Command Post*; others will relish the extra power in this new version. Earlier versions of the program offered only two commands: changing a directory and launching an application. The new version has rich menu language with over 90 commands including controlling the size and placement of applications when they start, displaying messages, and accepting user input. You can delay part of the menu commands until you close a window or send a filename to an application. In addition to this, *Command Post* also offers a file viewer and a handy on-screen clock.

The obvious gap in *Command Post*'s language is an almost total lack of branching capabilities. There is a backhanded way to do what is effectively an if statement, but the method is awkward and poorly documented.

CBM Desktop Office is for those who think that *Windows* didn't go far enough with its icon interface. It gives you a Mac-like desktop where you can place directories, files, and both running and unopened applications. You can print to any installed printer by dragging a file to it, and delete files or directories by dragging them to a trash can. You can drag a file to any running or unopened application and launch it.

Other options let you save the complete state of the desktop into a named desktop file, and later recall that workset. Unopened applications and files can have any BMP or ICO assigned as the icon while running with *CBM Desktop*; for example, when you run *Windows*, you use the default icon. The program ships with 150 sample icons and a separate file editor is also available for $79.95.

Windows Express is the happy medium between *Command Post* and *CBM Desktop*. Its design is similar to but better than *Windows*' Program Manager. The basic *Windows Express* metaphor uses folders rather than windows, but items have icons associated with them, just as in ProgMan.

A delightful icon editor lets you manipulate the 200-plus icons that the program ships with, or you can edit any icon you want to borrow from any application. However, you can only use these icons in the *Express* menus.

Menus can be any number of levels deep, and menu items can invoke a file dialog box to have the user pass a filename to a launched application. If you are producing menus for others, you'll find it especially useful that a panel of help text can be appended to any menu item. Because of the menu structure, the positions of menu choices don't change, and you can make choices with keyboard characters. Like ProgMan, the part of *Windows Express* used to produce menus has special links to the *Windows*' File Manager—you can drag any application or any file linked to an application to *Express* and have it added to a menu.

Also available from hDC is *FirstApps* ($100), a collection of nine micro applications including a bitmap and metafile paste utility, fractal-generated *Windows* wallpaper, viewers, autosave, and a game. ■

List Price: *Command Post* 7.0, $49.95 **Requires:** *Windows 2.x* or 3.0. Wilson WindowWare, 2701 California Ave. SW, #212, Seattle, WA 98118; (800) 762-8383.

CIRCLE 430 ON READER SERVICE CARD

List Price: *CBM Desktop Office*, $199.95. **Requires:** *Windows* 3.0. Desktop Office Publishing Technologies, 7719 Hollow Dr., #260, Austin, TX 78731; (800) 782-8324, (512) 346-2835.

CIRCLE 431 ON READER SERVICE CARD

List Price: *Windows Express*, $99.95. **Requires:** *Windows* 3.0. hDC Computer Corp., 6742 185th Ave. NE, Redmond, WA 98052; (206) 885-5550.

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First Looks

Charisma Brings Micrografx's Personality to Presentations

HANDS ON
by David Dean

Micrografx's $495 *Charisma* is aimed at harried business users trying to prepare for tomorrow's big meeting. To help them get there quickly, *Charisma* comes with 28 templates, 41 outline fonts, and 2,200 clip-art images. *Charisma* improves upon its predecessor's (*Graph Plus*) business and word charting tools, and adds drawing tools previously found only in Micrografx's *Designer* package.

Charisma provides standard business charting formats, such as line, bar, pie, area, and scatter plots. More esoteric techniques include linear regression, log-log, and shared scales, although there is no provision for true 3-D graphs (x, y, and z).

Charisma outshines Microsoft's *PowerPoint* and most DOS-based presentation graphics packages by importing both charts and source data from *Harvard Graphics*, *Lotus 1-2-3*, *Symphony*, and *Microsoft Excel*. There are no hotlinks to either *Harvard* or *Lotus*, but a DDE (dynamic data exchange) Paste Link macro links with *Excel*. Data can also be imported from *Visicalc* and *Enable/OA*.

Charisma greatly expands *Graph Plus*'s feeble word charting functions. Most notably, it offers a choice of bullet items selectable from thumbnail displays inside a bullet dialog box. Any piece of clip art can be transformed into a bullet, and bullets are easily aligned, both vertically and horizontally with corresponding text.

Charisma's 28 templates include chart layouts, fonts, and colors "guaranteed" to work together. The templates can be used with 20 combinations of predefined foreground and background colors, including gradients. However, if you create a gradient background, you must draw it as a separate object, and manually place it as a background object.

A subset of *Micrografx Designer*'s acclaimed drawing tools are available via *Charisma*'s pull-down menus or from an optional toolbox. If you don't need the tools, turn the toolbox off. Similarly, you can choose which tools you want in the toolbox, otherwise they are found in the pull-down menus.

Drawing tools include the Bezier tool. Not available in most presentation graphics packages, control over Bezier curves makes it easy to smooth drawings, manipulate fonts, and do detailed modifications. Some high-end *Designer* tools such as cookie cutter, autotrace, and layering aren't included, but *Charisma* users can import and export from *Designer*.

Unlike many packages that are limited to working with single pages, *Charisma*'s presentation pages are part of a larger workspace. The default workspace is 12 standard pages (each 7 inches by 10 inches); all can be viewed simultaneously. The number of pages you see depends on the page size you set in the View Pages dialog box. Once you choose this, the workspace (approximately 3 by 4 feet) is evenly subdivided; within the boundaries there is no limit to page size.

The workspace metaphor dovetails nicely with the built-in slideshow. For example, you might choose to include only every other page from the workspace into the slideshow script. While *Charisma* doesn't have speaker's notes or audience handouts per se, you can use the workspace to interleaf these pages with your slide presentation. Once you've tagged pages for the slideshow, *Charisma* can preset the duration of display and offers transitional effects, such as fade, wipe, and blend. There's even a built-in pointer with 10 different styles.

Micrografx provides plenty of clip art. In addition to the 1,700 found in *Designer*, 500 additional images cover technical illustrations, maps, standard forms, and stationery. Much of it is in color; all of it is editable, and seven additional specialty libraries are available. Clip art can be previewed as black-and-white thumbnails or full-size color images.

Most standard import/export filters (.PCX, .TIF, .PICT, .CBM, .DXF, etc.) are included; however, there is no .EPS import filter. Also like *Designer*, *Charisma* has limited font import facilities.

The Telegrafx module, which is installed as a printer driver, can send specially created compressed .SCDL files of your *Charisma* images directly to slide-service bureaus via modem transmission. A menu prompts you for billing and ordering information. For now, only two service bureaus are supported directly via Telegrafx, although any bureaus that images .SCDL files can create slides from *Charisma*.

Output support is exemplary. Micrografx provides printer driver support for output devices such as laser printers, color PostScript printers, and slideshow output to the screen (including 8514 monitors). *Charisma* also offers batch printing.

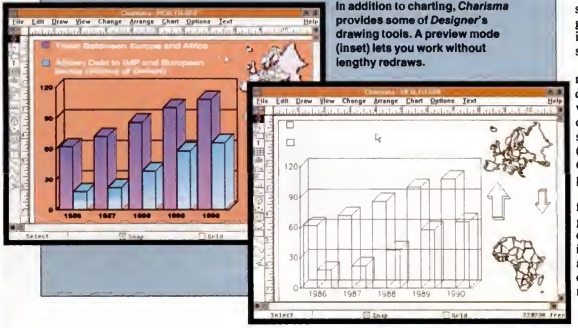
Charisma ups the ante for features in PC presentation graphics programs. By offering drawing, clip art, text and charting power tools in a single package, *Charisma* should draw lots of attention, especially in board rooms and seminars. ■

FACT FILE

PC MAGAZINE

Charisma, Version 1.0
Micrografx Inc., 1303 Arapaho, Richardson, TX 75081; (800) 272-3729, (214) 234-2410.
List Price: $495. (Free upgrade from *Graph Plus* if purchased after 6/1/90, otherwise $99.)
Requires: *Windows* 2.11 or 3.0, 1MB RAM.
In Short: *Charisma* enhances *Graph Plus*'s charting tools, adds an intelligent subset of *Designer*'s drawing tools, tosses in clip art, fonts, a slideshow feature, and file filters for a strong presentation graphics package.

CIRCLE 624 ON READER SERVICE CARD



In addition to charting, *Charisma* provides some of *Designer*'s drawing tools. A preview mode (inset) lets you work without lengthy redraws.

Scalable LaserJet Fonts for WordPerfect

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Prestige Corporate Buckingham Coronation Script PENWIN
Gibraltar Souvienne University Ornate Oxford Rockland
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Avant Guard Aero GREEK AB$∫ 01 Exchequer Script Katrina
Joulliard Zingbats ❝❶✆ Roman New York Deco
Garamand Condensed Padua Courier Bongo Black

Glyphix fonts install automatically in minutes and activate all of the font options in your WordPerfect (Ctrl-F8) font menu. Just select a font, a style and a point size from 3 to 120 point—you can even get effects like reverse, shadow and outline right from the menu. When you print, the Glyphix fonts you selected are generated automatically on-the-fly in just seconds.

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- Standard LaserJet Plus, Series II, IID, IIP or compatible printers
- No additional printer memory required
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- Portrait and landscape
- Regular, bold, *italic* and ***bold italic***
- Reverse, outline & 20 other effects
- International character set

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CIRCLE 299 ON READER SERVICE CARD

Grow Your Own Keyboard with Datadesk's Innovative, Modular Switchboard

HANDS ON
by Jonathan Matzkin

The keyboard is the most personal part of any personal computer. If you doubt that, ask any five PC users about their preferences in keyboard layout and tactile response. You're likely to get five completely different answers.

Many confirmed *WordPerfect* users demand function keys on the side, for instance, while people who cut their teeth on PS/2s are lost if they don't find their function keys in a single row across the top.

The Switchboard, an ingenious new keyboard design from Datadesk, aims to satisfy keyboard pounders by letting them make fundamental design choices for themselves. The $239 Switchboard is a frame that accepts a variety of snap-in keypad modules. An alphanumeric module contains the standard QWERTY keys, along with keys such as Alt and Ctrl. The Switchboard also comes with two additional modules: one is a numeric keypad, the other is a cursor pad with a t-shaped cursor key arrangement and PgUp, PgDn, Ins, Del, Home, and End keys.

These three modules sit side by side, and can be rearranged in the frame in any order. If you are a financial analyst and want to place the numeric keypad to the left of the QWERTY keys and the cursor pad to the right, simply snap the modules into the frame in that order.

A permanent row of 15 function keys sits above the snap-in modules. At the top of the keyboard, a plastic cover conceals a receptacle that accepts another snap-in module. The receptacle also holds two banks of dip switches that match the Switchboard to a particular system. The switches also allow you to reverse the placement of the Caps Lock and Ctrl keys, and allow access to the comma and period even when the left Shift key is depressed.

The Switchboard would be innovative enough even if it only allowed you to rearrange the various keypads to suit your preferences. But Datadesk also offers a selection of optional keypads. Perhaps the most intriguing is the trackball, which can take the place of either the numeric keypad or the separate cursor pad.

The Microsoft-compatible trackball ($145) uses the same Logitech-manufactured ball mechanism employed in the Macintosh portable. A bottom-mounted "click bar" emulates the left mouse button. Either of two buttons mounted on opposite sides of the ball emulates the right button.

I found myself using Datadesk's trackball (a preproduction model) more than I had expected, even though I'm not particularly fond of mice. Its stationary position as an integral part of the keyboard gives the Datadesk trackball an advantage over mice and standalone trackballs, for there is no cord. Normally, when looking for my mouse, I first have to locate the cord and then reel the rodent in like a caught fish.

This flexibility would be wasted if the Switchboard came up short on typing ergonomics. Fortunately, Datadesk hasn't skimped on the hardware. The high-quality keyswitches have an uncommonly smooth action and a noticeable detent where the keystroke registers. The detent generates a clearly audible click, but Datadesk will honor special orders for keyboards without the click. Typing on the Switchboard is a pleasure; its "feel" compares favorably with just about any other keyboard I've tried.

Datadesk's Switchboard is the first completely modular keyboard system; it allows users to reorganize the key layout and add options.

While it sounds tempting to reconfigure the Switchboard to match a particular mood or application, most users will find redesign more trouble than it's worth. It takes some effort to snap the modules in and out, and each must be connected to its new location via a multipin connector cable. The best approach is to customize the layout initially, and then leave it alone. Occasional rearrangement to suit changing preferences or to include new modules should present little difficulty, however.

Datadesk plans to offer a parade of new modules for the Switchboard in the future. A Dvorak key layout, which groups keys by frequency of use, will be available as an option ($59.95) in place of the standard QWERTY module. A 3270 emulation pad (tentatively priced between $99 and $129) will snap into the receptacle at the Switchboard's upper edge. A vertical function key module (which will sell for between $29 and $39) will make dyed-in-the-wool *WordPerfect* users happy. Datadesk says it is also developing a digitizing tablet and a calculator keypad.

Datadesk has also discussed future plans to include a full-fledged expansion bus in the Switchboard. That would allow you to connect a mouse directly to a keyboard-mounted serial port, or use a number of other hardware options by connecting them to the keyboard.

About the only other thing I wish the Switchboard would do is allow me to more flexibly configure the key layout of the main alphanumeric module. Most common placements of the backslash key get me in trouble, because I reach for it and hit Enter by mistake. So I'd like to be able to move individual keys around to suit my personal idiosyncracies.

Though the Switchboard is pricey when fully configured, it's hard to place a value on such a high degree of user configurability. If you've tried many different keyboards, none of which is exactly right, the Switchboard might be just your type. ■

FACT FILE

Switchboard
Datadesk, 9314 Eton Ave., Chatsworth, CA 913211; (818) 998-4200.
List Price: Switchboard, $239; optional trackball, $149; Dvorak keypad, $59.95.
In Short: An innovative keyboard design that allows users to virtually construct their own layout. Optional snap-in keypads provide a wide variety of additional functionality.

CIRCLE 442 ON READER SERVICE CARD

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Lotus Freelance Plus 3.01

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Software Digest's award was presented for Freelance Plus Release 3.0. Release 3.01 is identical, but uses less memory.

Substantial proof tha

with power and spe

In the terminology of the modern workplace, power and speed have become the shorthand by which personal computers are measured.

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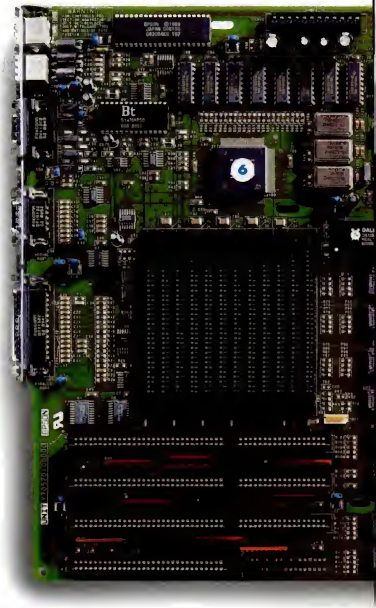
1 *VLSI Chips. The compact footprint of Epson's new machines is made possible by integrating functions on VLSI chips such as these. Without them, separate boards would require separate slots, and the motherboard alone would be three times the size.*

2 *Surface Mount Technology. Used only by the most advanced manufacturers, SMT techniques protect the structural integrity of the board, which increases overall reliability.*

3 *Hard Drive Controller. The use of Integrated Drive Electronics on the hard disk eliminates the need to add a hard disk controller board. This simplified design means faster throughput and greater reliability.*

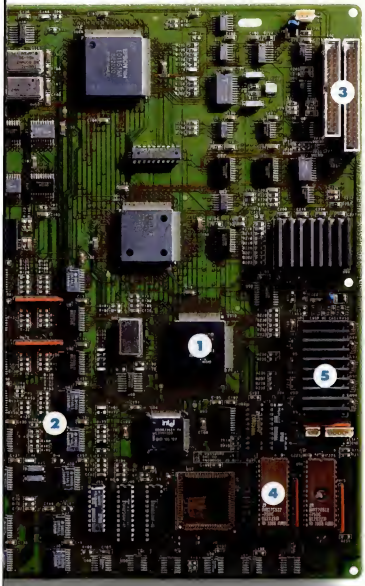


Epson's 386SX motherboard displays the elegant architecture necessary for optimal performance.

Feature configurations may vary with different models. Board shown is not actual size. 386 is a trademark of Intel Corporation. Epson is a registered trademark of Seiko Epson Corporation.

t in a world obsessed

ed, neatness counts.



4 *Epson's proprietary BIOS. Epson has elected to develop its own BIOS, customized for each individual system, simply to ensure that your software will get the most out of our hardware.*

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What the Epson design team has discovered is that *less* is very definitely more. By reducing the number of separate components through integration, performance is increased. The result is a flexible tool which is elegant, efficient and allows the effortless application of power and speed to the task at hand.

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CIRCLE 220 ON READER SERVICE CARD

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First Looks

Canon's Bubblejet: A Great One for the Road

HANDS ON
by Jonathan Matzkin

Until recently, the portable inkjet printer market was dominated by the Diconix 150 Plus (We gave it an Editor's Choice award, November 14, 1989, issue). The diminutive Diconix, offered relatively sharp and clean results, at a healthy 70 characters per second. But, the debut of Canon's $499 BJ-10e offers a serious portable printing alternative. Though noticeably larger than the Diconix, the Bubblejet is still small enough (1.75 by 12.25 by 8.5 inches HWD) to slip unobtrusively into a briefcase. Weighing in at about 4.6 pounds (and that's including its optional nickel cadmium battery pack) it falls into the same weight class as the industry leader.

Like the Diconix, the Canon has an eye-pleasing, streamlined design. During testing in PC Labs, the Bubblejet's sleek, modern lines caught the attention of all passersby. It reminded more than one observer of a fax machine, but with its combination paper-guide/output tray folded down, the unit actually looks more like a laptop.

Plain paper output from the Bubblejet is basically sufficient for all but the most critical business uses. When set for best-quality print, the machine produces dark, well-formed characters that easily rival 24-pin dot matrix output. Close scrutiny of the printed page reveals some "wicking," but that can be attributed in part to the ordinary photocopier paper used in our tests. Like most inkjets, the Bubblejet produces its best output on specially coated inkjet paper.

While the BJ-10e and Diconix are evenly matched in terms of print quality, the Bubblejet digresses when it comes to print speed, at least in draft mode. The Diconix buzzes along at 70 characters per second in draft mode, while the Bubblejet, by contrast, plugs along at about 40 cps in draft. In NLQ (near letter quality) mode the speed difference evaporates. The Diconix drops to about 31 cps in quality mode, the Bubblejet clocks in at about the same 40 cps that it manages in draft mode. If you use mostly NLQ printing the Canon has the edge.

A more important advantage is the Bubblejet's optional sheet feeder. The $90 tray holds 30 sheets and snaps easily onto the bottom of the printer. When operating with the sheet feeder, the Bubblejet stands on its side; the whole contraption takes up a very small 12-inch by 4-inch footprint. With the output tray folded down, the Bubblejet takes a bit more desk space, but should still fit easily on a crowded desktop. The sheet feeder eliminates the drudgery of hand feeding individual sheets. The Diconix has no similar counterpart.

The limited 30-sheet capacity disqualifies the Bubblejet from heavy office use, but the feeder-equipped 10e could be ideal for students, home professionals, and others with light printing needs.

The Bubblejet emulates Canon's larger BJ-130e inkjet, as well as the industry standard IBM X24E dot matrix printer. It sailed through tests for graphics compatibility with the IBM. So faithful is the emulation that, while printing a scanned image under IBM emulation, the Bubblejet faithfully reproduced the very same graphics registration problems that plague the IBM machine.

The 10e features five front-panel switches and an on/off toggle mounted on the side of the case. The switch functions are well chosen and make the Bubblejet simple to operate. One intelligent design decision combines the line-feed and form-feed functions in a single switch. Tap the switch once, and you get a line feed; hold it down, and the 10e initiates a form feed.

You can select print quality (NLQ and draft) with a single switch; high- and low-pitched beeps from the printer's speaker reveal the current print status. Print pitches of 10, 12 or 17 cpi (or proportional spacing) are also selectable from a single front-panel switch that incorporates beeps of different pitch to let you know which pitch you've selected.

While battery life claims are notoriously hard to confirm, Canon reports that the 10e will print approximately 30 pages of output with an average of 1,500 characters per page before needing a recharge. That seems a bit limiting, since a single large print job could easily exceed this page count. This is only a serious limitation to those who must spend extended periods away from an AC source. Long airline flights might be a problem, but many, if not most, other locations (such as hotel rooms) allow the user to simply plug in and print.

Canon's littlest Bubblejet is an outstanding addition to their printer line. It combines style, functionality and a very reasonable price, all in a sleek, small package. Introduce it to your laptop, and you'll have a mobile system that's ready to meet the road. ■

Canon's new BJ-10e offers high-quality output and portability.

FACT FILE

Canon BJ-10e
Canon USA, 1 Canon Plaza, Lake Success, NY 11042; (800) 848-4123.
List Price: $499. Sheetfeeder, $90. Rechargeable battery pack, $50. Replacement print head ink cartridges, $25.
In Short: A portable pleasure, the Bubblejet produces quality output. Its sheet feeder makes it a practical travel companion.

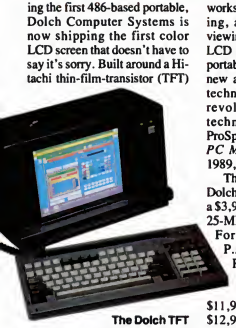
CIRCLE 437 ON READER SERVICE CARD

Once you've torn down all of the
laws in the country and you find
yourself face to face with the
Devil, what will you hide behind? -Becket
10CPI Bold Underline Compressed Italic Superscript Su
NLQ 10CPI Bold Underline Compressed Italic Superscrip
Proportional 10CPI Bold Underline Compressed Italic Supersc
d

Dolch Offers First Portables to Use Active-Matrix LCD Technology

HANDS ON
by Mitt Jones

Quick on the heels of introducing the first 486-based portable, Dolch Computer Systems is now shipping the first color LCD screen that doesn't have to say it's sorry. Built around a Hitachi thin-film-transistor (TFT) panel, the 10-inch, VGA display generates colors that are every bit as deep and vibrant as those of a standard CRT. It works with virtually no ghosting, and without the narrow viewing angle that limits most LCD screens. This is the first portable product to utilize the new active-matrix, color LCD technology that promises to revolutionize video display technology (see "The NEC ProSpeedCSX Stands Alone," *PC Magazine*, October 31, 1989, p. 36).



The Dolch TFT color LCD Screen boasts 8 colors and measures 8.4 by 6.3 inches (WxH).

The bad news is the price. Dolch is offering the display as a $3,995 option, and only for its 25-MHz 386 and 486 models. For the lunchbox, Dolch P.A.C. 386-25C with 2MB RAM, a 40MB hard disk, and the color display, you'll pay a total of $11,990. Add the display to the $12,995 Dolch P.A.C. 486-25, with its 100MB hard disk, and the price jumps to $16,990.

Though available for well over a year as prototypes, large active-matrix LCD panels are still difficult to manufacture in quantity. Unlike traditional LCD screens, which use a grid of electrodes to control the state of any given pixel, active-matrix displays dedicate a transistor to each and every pixel. While this greatly reduces pixel response time and greatly increases screen contrast and color saturation, it creates formidable manufacturing challenges.

With a red, green, and blue pixel per every logical pixel, and with a resolution of 640-by-480 logical pixels, the TFT layer of the Dolch display must hold a minimum of 921,600 transistors. If a few transistors turn out to be bad, you're left with a black hole in your otherwise-colorful display. To offset this problem, Hitachi includes a fourth "spare" transistor for each logical pixel, bringing the total number of transistors to over 1.25 million. The bottom line is that Dolch expects to manufacture only 50 to 100 displays a month, and 100 is probably optimistic.

The final bit of bad news concerns the implementation of the VGA display. Though hailed as "fully VGA compatible," the display is capable of only 8 simultaneous colors and is totally incapable of operating in video modes 0, 1, 4, 5, 7, 13, 15, and 19. The Ahead Systems controller supports simultaneous use of both the LCD and an external VGA monitor, but the external monitor fails to synchronize properly in modes 2, 3, 7, and 15. Dolch reports that it's working on a new controller that will resolve incompatibilities and provide a 256 simultaneous color display.

Despite its cost, limited availability, and functional limitations, the Dolch TFT color LCD should appeal to some sales, service, and CAD professionals. No other color LCD screen available thus far even comes close to generating such sharp images, and the compatibility limitations should prove more of an irritation than a insurmountable problem. Still, those who can wait for these color capabilities may be best off; more-capable, less-expensive offerings by Dolch and others are sure to follow. ■

List Price: Dolch TFT Color LCD, $3,995 above the price of the Dolch P.A.C. 386-25C or the Dolch P.A.C. 486-25 lunchbox portables. Not sold separately. Dolch Computer Systems, 2029 O'Toole Ave., San Jose, CA 95131; (800) 538-7506, (408) 435-1881.

CIRCLE 441 ON READER SERVICE CARD

PFS:Preface—A Low-Effort DOS Shell

HANDS ON
by Bruce Brown

PFS:Preface, a $69 DOS shell program, continues Software Publishing Corp.'s tradition of simple functionality.

PFS:Preface is a memory-resident program that needs just 10K. The program includes functions most DOS shell users look for: a menu program for starting applications, a disk and file manager, and a DOS command access and reference tool.

PFS:Preface's menu system sets up program menus with customized menu titles and automatically installs menu items by searching your drives for the executable files of 145 common programs. Because the names of the program(s) are stored as editable ASCII files, you can modify this listing.

To create menu items, just tell *PFS:Preface* where the program files reside and the command necessary to start the program. Menu items can also run any DOS executable command, and menu direction commands such as Next Page.

The maximum number of items per menu is 14, but you can create and edit multiple-level menus and submenus with *PFS:Preface*'s cut-and-paste toolset. Multiple menu sets can coexist on the same computer.

Using the program's simple menus couldn't be easier. Online help is always an F1 key away, but constant screen prompts make the help screens unnecessary. The manual has clear instructions and explanations of on-screen displays.

PFS:Preface's File and Disk Manager helps with common directory and file functions. There are menu choices to create, change, delete, and rename directories, the latter a facility not available under DOS. You can sort files by filename, file extension, date and time, or size. You can use *PFS:Preface* to manipulate files as well. When selecting multiple file operations, you can tag individual files, tag by wildcards, or select all files in a single directory. The File View function works only with ASCII files; file searches can be based on filenames but not contents.

PFS:Preface's DOS command window includes 37 commonly used DOS commands plus a DOS command line to add parameters or other DOS commands. Included DOS commands are displayed in a list that's augmented by a help screen detailing the currently highlighted command.

Programs such as *PC Tools Deluxe*, Version 6.0, and *XTreePro Gold* have more features. *PFS:Preface* doesn't have tree-style directory views, program launching from directory listings, native format file viewing, or a memory-juggling application switching feature. It's best suited for beginners and casual users and is priced competitively with other low-end commercial shell programs. ■

List Price: *PFS:Preface* 1.0, $69. **Requires:** 512K RAM, hard disk, DOS 2.1 or later. Software Publishing Corp., P.O. Box 7210, 1901 Landings Dr., Mountain View, CA 94039-7210; (415) 962-8910.

CIRCLE 440 ON READER SERVICE CARD

Multitasking without tears.

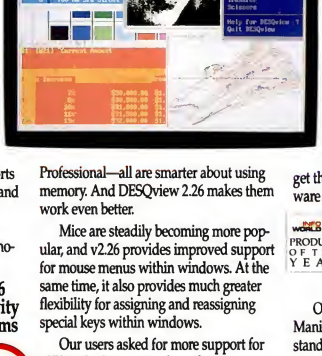
Thank goodness complicated programs like Microsoft Windows and OS/2™ aren't the only way to multitask and window on the PC.

DESQview runs the programs you know and love in multiple windows, multitasks them and even lets you use a mouse. And it does it all today. In fact, DESQview's been doing it for over four years now.

People all over the world are using DESQview to cut and paste data between programs running in multiple windows. They're running sorts and recalculations in the background, and they're operating in text and graphics modes in windows side-by-side. No drama, no fireworks and no huge memory or disk space requirements.

Introducing DESQview 2.26 It gives you greater productivity by multitasking more programs

The latest generation of DOS programs is getting better at using memory. Lotus 1-2-3 v2.2 and Release 3, Metro, Freelance, Microsoft Word, AutoCAD 386, Ventura Publisher



Professional—all are smarter about using memory. And DESQview 2.26 makes them work even better.

Mice are steadily becoming more popular, and v2.26 provides improved support for mouse menus within windows. At the same time, it also provides much greater flexibility for assigning and reassigning special keys within windows.

Our users asked for more support for 3270 and other terminal emulation. DESQview v2.26 has it.

You asked for support for a wider range of hardware: CD-ROM, scanners, comm ports, etc. v2.26 has it.

And you asked for help in handling troublesome TSRs. DESQview helps straighten them out.

DESQview 2.26 Improved to better fit the way you work.

At Quarterdeck, our philosophy has always been to increase your productivity in logical, economical steps—not to reinvent a system that works for you.

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Some of DESQview's recent awards

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CIRCLE 338 ON READER SERVICE CARD

Twists on the Removable Storage Theme

HANDS ON
by Alfred Poor

Two new removable media, each with 20MB storage capacity, offer hi-tech solutions but for different problems. While Q/COR's Stor/Mor—based on floppy disk technology—is inexpensive but slow, DISCTEC's RHD-20, which uses hard disk technology, offers faster performance with a steeper price.

The Stor/Mor device from Q/COR looks like a standard 3.5-inch disk drive, but uses Brier Technology's Twin Tier Tracking design and relies on special disks with prewritten positioning information. The read/write head can read 777 tracks per inch instead of the mere 80 tracks per inch used on a standard high-density 1.44MB 3.5-inch floppy disk. The design uses vertical recording techniques so that a continuous servo track is recorded deep in the disk's surface; the data is then written on top of the servo information. A pair of heads are used to read these two-level tracks.

The drive is relatively easy to install. It uses an embedded SCSI interface, and comes with its own interface card. The documentation includes instructions for removing terminating resistors and changing SCSI ID numbers in case you need to daisy-chain the drive with other SCSI devices. The only other necessary step is adding a device driver to your CONFIG.SYS file.

The Q/COR drive is best suited for backup applications or systems where access speeds aren't critical. The company claims a 35-millisecond track-to-track average access time which rivals older hard disks. But, since the floppy disk drive does not turn as fast as a hard disk, the transfer rates don't always measure up to the specification. Our tests show the drive performs about the same as a floppy disk drive in some cases, and up to three times faster in others, depending on the record size. These results indicate that it's more sensible to use the Stor/Mor as a data backup or transfer device rather than as a primary storage drive.

It would be easy to install multiple Stor/Mor interface cards in computers around the office, and use the Stor/Mor as a transportable backup drive. The specially formatted disks cost only $25 each, only a little more than a dollar per megabyte—a cost effective storage solution.

The DISCTEC RHD-20 crams a standard 2.5-inch 20MB hard disk drive complete with an IDE interface into a small, sealed plastic cartridge that's slightly smaller and heavier than a Hewlett-Packard LaserJet font cartridge. The drive bay has a roomy 3.5-inch drive form factor; it could be made even smaller.

Stor/Mor looks like a normal 3.5-inch drive, but it holds almost 10 times as much data.

According to a company representative, the drive has been designed to make it attractive to manufacturers of both portable and desktop computers. In fact, the company already offers special kits for the Compaq LTE and the Zenith SuperSPort Model 2 and higher.

The RHD-20 attaches directly to an IDE interface. If you don't have an IDE there are other 8- and 16-bit controller cards, depending on whether you have an XT or AT-type computer. We used a 16-bit (IDE) controller in peaceful coexistence with a Western Digital ESDI controller. The only other installation step involved adding a device driver to the CONFIG.SYS file. If you are running the RHD-20 as the primary drive, you will also need to run a small TSR that watches out for cartridge changes.

The RHD-20 demonstrated hard disk type performance figures, just a bit off the pace set by the ESDI drive. If you run your system with good cache software, you are not likely to see a speed difference between this unit and most other hard disk drives. But performance has its price—the removable cartridges cost $595 apiece, about 20 times more per megabyte than the slower Q/COR media. As a result, the RHD-20 is more likely to appeal to the portables crowd, where reduced weight and size are critical, but full-size hard disk performance is required.

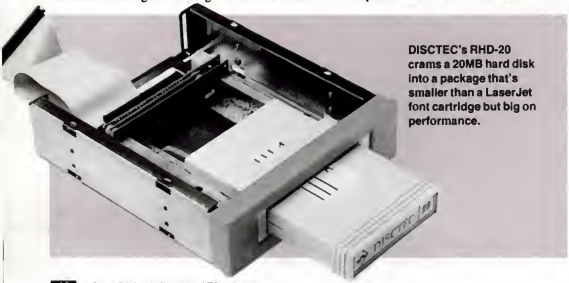
Both devices worked without surprises in our tests, and each appears well suited for its targeted tasks. If you're looking for new, lightweight ways to put 20MB in your pocket, then these are two new designs worth consideration. ■

List Price: *Stor/Mor:* External unit with 8-bit controller, cable, and one disk, $895 (MCA version $995); internal unit with 8-bit controller and one disk, $795. 20MB preformatted disk, $25. Q/COR, One Quad Way, Norcross, GA 30093-2919; (404) 923-6666.

CIRCLE 436 ON READER SERVICE CARD

List Price: *RHD-20:* 20MB cartridge, $595; cartridge with IDE docking RHD-20 bracket, $640; cartridge and bracket with 8-bit IDE controller, $670; cartridge, bracket, and 16-bit IDE and floppy controller, $695. DISCTEC, P.O. Box 1750, Winter Park, FL 32789; (800) 553-0337, (407) 645-0001.

CIRCLE 438 ON READER SERVICE CARD



DISCTEC's RHD-20 crams a 20MB hard disk into a package that's smaller than a LaserJet font cartridge but big on performance.

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Three Turbo-charged Programming Tools From Borland International

HANDS ON
by Richard Hale Shaw

Borland International's recently released Turbo C++ Professional (First Looks, August 1990, issue), included three powerful programming tools: Turbo Debugger 2.0, Turbo Assembler 2.0, and the new Turbo Profiler 1.0. But now anyone who uses a Borland language or can generate a CodeView-compatible symbols table can have the same power tools. Turbo Debugger and Tools is available as a $149.95 package which includes all three of the Borland/Microsoft languages-compatible programs.

TURBO DEBUGGER 2.0

Borland's Turbo Debugger 1.0 won the *PC Magazine* Technical Excellence Award in 1988. Especially noted were its multiple overlapping windows which let you view different aspects of program execution and walk through data structures, arrays, and linked lists.

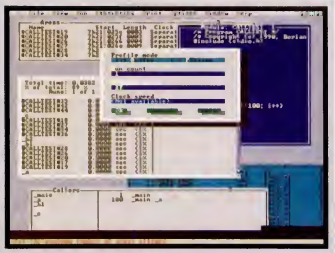
Borland continued to improve the interface. Like Turbo C++, the desktop interface includes movable, sizable, mousable windows that display source code, data, program variables and stacks, debugger messages, and CPU registers. You can also set breakpoints, display memory in a variety of formats, follow pointers, and scroll through arrays.

Every aspect of the Debugger interface—window sizes, positions, start-up displays, etc.—can be saved to a configuration file; you can use different configuration files for different programs or needs. Since the environment is fully mousable you'll only need the keyboard to type in expressions and assign variables. The result is a more passive, reflective debugging session, which is as it should be.

In addition, Debugger offers Turbo Pascal 5.5 and Turbo C++ OOP support via a window that displays a hierarchical tree of object and class types, as well as the parents of classes derived through multiple inheritance. Debugger properly handles the late binding of virtual methods, and lets you view or step through the components of a class instance.

Programmers may find Debugger's niftiest feature to be UNDO, which reverses program execution in multiple, user-specified steps. Keyboard macros can be created to assign any series of commands and keystrokes to a single key, and use the macro to restart and replay a session up to a particular point. Breakpoint counters stop program execution when a specified number of breakpoints are reached, and "code-splicing" (the execution of a code expression when a breakpoint occurs) is available. You can even use Turbo C's pseudo-register variables in code expressions.

Finally, Debugger is memory efficient. It automatically uses available EMS to store a program's symbol table. On an 80286 or 80386 machine with at least 512K of extended memory, Debugger loads itself into extended memory and switches to either 286 protected mode or 386 virtual mode, leaving most, or all, of 640K for the target application.



Like its companion, *Turbo Debugger*, *Turbo Profiler* offers a mousable environment with multiple, movable, sizable windows. Unlike other profilers, this one is interactive with pull-downs, pop-ups, and scrollable list boxes.

PC MAGAZINE FACT FILE

Turbo Debugger and Tools
Borland International, 1800 Green Hills Rd., P.O. Box 660001, Scotts Valley, CA 95066-0001; (408) 438-8400.
List Price: $149.95.
Requires: 384K RAM (256K for Turbo Assembler), hard disk, DOS 2.0 or later.
In Short: A must-have for every DOS programmer using Borland or Microsoft languages. Includes an award-winning interactive debugger, an interactive profiler, and a fast, MASM-compatible assembler.

CIRCLE 434 ON READER SERVICE CARD

TURBO PROFILER 1.0

Once your program is working correctly, you need to make it fast. This is done primarily by determining which parts of the program are used the most and take the most time. Optimizing timing is a job for a profiler. Unlike other profilers, which are run in batch mode from the command line, Turbo Profiler is an interactive profiler.

Using debugger information produced for Turbo Debugger or Microsoft's CodeView, Turbo Profiler lets you customize the profile by combining passive profiling—which uncovers problem sections by collecting program execution information at every CPU clock tick—with active profiling, which finds specific target functions and statements that need optimization. Profile results are returned as a set of statistics, histograms, execution counts, and time measures.

For instance, Turbo Profiler can tell you how long a function took to execute, how many times the function was called, and which functions did the calling. It can show you how much time your program spends on file I/O, letting you know when to add or optimize buffering schemes, and it can monitor interrupt calling down to specific subfunctions. Like Turbo Debugger, Turbo Profiler supports remote access from another machine and takes advantage of extended memory. Its statistical reports can be sent either to the printer or disk.

TURBO ASSEMBLER 2.0

Of the three programs included in this package, Turbo Assembler offers the least, but not the least significant, number of improvements. For instance, you can now specify the number of passes TASM will make, allowing it to remove NOPs inserted during earlier passes. (You can also stick to 2-passes for compatibility with Microsoft's Macro Assembler.)

TASM offers useful extensions to assembly language. The CALL statement takes arguments and pushes them onto the program's stack; it also specifies which language-calling convention is being used. You can now use PUSH and POP with more than one argument, and even use several i486 instructions. Finally, TASM supports forward-referenced macros, and makes it easier to assemble code for *Microsoft Windows* or *Windows*' DLL (dynamic link libraries). ■

'386 Systems. The similarity ends here. Why?

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HANDS ON
by Lee Mandell

Until now, if you wanted to integrate full motion video and digitized audio on a single board, your only hope was to hold out for Intel's DV/I. With the appearance of IBM's M-Motion Video Adapter/A, the wait may be over. This new Micro Channel add-in combines video and digitized stereo audio, and rounds out IBM's broad multimedia product line. It will compete directly against other full-motion video boards such as the well-received DVA-4000 from VideoLogic (First Looks, Feb. 27, 1990).

The InfoWindow-compatible M-Motion board receives signals from up to three NTSC/PAL inputs, or from two Super VHS (Y/C) inputs. Analog signals can originate from any standard video source such as a videodisk player, a VCR, or a live camera feed. Once the incoming information is processed and digitized, it can be displayed on a standard PS/2 color monitor as either live motion or still-frame video. On the audio front, M-Motion accepts input from up to two standard stereo input sources, digitizes and stores the audio, and then plays it back via an external speaker or headphones.

The accompanying memory resident *M-Control* software transforms the M-Motion board into a bonafide multimedia environment by offering complete control of the video and audio inputs. *M-Control* can superimpose computer graphics over video, size and place video windows, and create multiple video images on a single screen.

Programming the board requires communicating with *M-Control* using C or an authoring system that has a driver for M-Motion. The send and receive commands—the heart of communication with *M-Control*—consist of five fields: size of buffer, ID, destination, command, and data. IBM provides C source code for some basic programs which play and record digital audio and control video functions.

Digital video from the M-Motion board is good, but the analog version of the same image is better. In a side-by-side comparison of the digitized M-Motion video (on an 8514A monitor) and the analog image from IBM's turnkey InfoWindow system, we found a noticeable stair-stepping on M-Motion's curves and fonts. The M-Motion also had difficulty with certain colors (a light blue sky, for example) and had trouble representing diagonal motions.

The M-Motion board offers considerable audio-visual functionality for users willing to brave its low-level interface. The digital audio capabilities are particularly welcome, and will be of value in authoring increasingly sophisticated multimedia presentations that include integrated high-quality graphics, video, and sound. ■

List Price: M-Motion Video Adapter/A, $2,250; *M-Control*, $150. **Requires:** MCA-bus system with free video slot, DOS 3.3 or later, or OS/2 Presentation Manager Standard and Extended editions (1.2 or later). IBM Multimedia Marketing Solutions, 4111 Northside Pkwy., Atlanta, GA 30055; (800) 627-0920.

CIRCLE 623 ON READER SERVICE CARD

inFocus Magnifies Any Display

HANDS ON
by Luisa Simone

If you are visually impaired, find laptop screens hard to read, or simply suffer from eyestrain, *inFocus*, a $149 utility from AI Squared, can help. Unlike *Eye Relief*—the dedicated big-type word processor (reviewed in First Looks, February 27, 1990)—*inFocus* produces an enlarged view of your display without asking you to abandon your favorite application.

We successfully loaded *inFocus* with DOS, *WordPerfect*, *Lotus 1-2-3* 3.0, *Windows* 2.10, and *XyWrite*, but sometimes compatibility was an issue—especially with extended VGA adapters and with programs that took direct control of the keyboard. And be warned: since it's a TSR, *inFocus* steals 50K of base memory, which means you may have problems working with extremely large files if your program does not support expanded or extended memory.

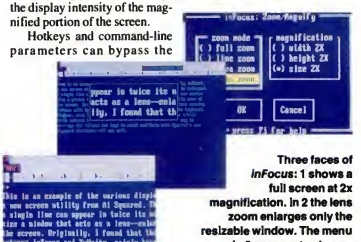
Not surprisingly, *inFocus* offers its most varied options when you use character-based programs. You can choose to display a full-screen window, a single line of double-size type, or a resizable window that acts like a magnifying glass. Actually, the single magnification level (200 percent) is really all you'll need.

Luckily, *inFocus* provides a host of viewing controls that are easily accessed via an oversized pop-up menu. From within your application you can resize the area-zoom windows, decide how scrolling windows will move in relation to the cursor, have *inFocus* track your mouse as well as the cursor, choose a new panning pattern, or change the display intensity of the magnified portion of the screen.

Hotkeys and command-line parameters can bypass the menu. The latter also gives crucial installation options. For example, in order to get the program to work with *XyWrite*, I had to load *inFocus* with a special parameter that allowed it to steal the keyboard handler back from the word processor. I also created customized definitions of the *inFocus* hotkeys that did not conflict with *XyWrite's* Alt-key combinations.

Even when you are savvy to potential installation conflicts, there are some limitations you'll have to learn to accept. For example, the only zoom mode for graphics programs is full screen and *inFocus* will only support VGA—a real limitation for portables users.

On a more subtle level, you'll find that you lose the ability to track cursor movement within *Windows* 2.*x*, although a bundled utility called WinFocus lets you track mouse movements. You'll also be forced to use the special screen-scrolling commands (Alt-Arrow key) extensively with certain applications. *Lotus 1-2-3*, for example, scrolls cell by cell, which often creates a mismatch between the true cursor position and the *inFocus* screen image.



Three faces of *inFocus*: 1 shows a full screen at 2x magnification. In 2 the lens zoom enlarges only the resizable window. The menu in 3 pops up to change *inFocus*'s parameters from within your application.

Despite these stumbling blocks, *inFocus* can provide a new level of computing comfort at a reasonable cost. ■

List Price: *inFocus*, Version 1.01, $149. **Requires:** 50K of free RAM, VGA graphics adapter, VGA-compatible monitor, DOS 2.0 or later. AI-Squared, 1463 Hearst Dr. NE, Atlanta, GA 30319; (404) 233-7065.

CIRCLE 439 ON READER SERVICE CARD

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PC MAGAZINE *"Don't pass over the CPU 286 12MHz" —Sept 1989*

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*Prices listed are available with complete system purchase only.

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- 1.2MB OR 1.44MB FLOPPY DRIVE
- 101-KEY TACTILE FEEDBACK KEYBOARD
- 2 SERIAL PORTS, 1 PARALLEL PORT AND 1 GAME PORT
- 8 EXPANSION SLOTS
- KEYBOARD SELECTABLE CPU SPEED
- REAL-TIME CLOCK/CALENDAR AND BATTERY
- SUPPORTS INTEL 80387 & WEITEK 3167 CO-PROCESSORS
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CIRCLE 163 ON READER SERVICE CARD

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The Press goes on to mention that because DR DOS 5.0 is fully DOS compatible, you can run all your current DOS applications. And because it is easy to install and requires no hard disk reformatting, upgrading to DR DOS is simple. Since DR DOS 5.0 also includes ViewMAX™, a graphical interface, DOS is easier than ever to use.

Now if we could just get a word in edgewise, we would simply like to add that DR DOS 5.0 is available now. Call us at (800) 848-1498 Dept. DR-74 today.

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by Rink Murray

New&Improved

News of Announced Products and Upgrades

Compaq, CompuAdd, DataWorld, and GRiD Introduce New Laptops

NEW

Compaq SLT 386s/20, Deskpro 386s/20

Fostered by the introduction of Intel's 20-MHz SX chip, Compaq has expanded its line with two higher speed SX computers: the Compaq SLT 386s/20 laptop and the Compaq Deskpro 386s/20 desktop. According to Compaq, the SLT 386s/20 features faster performance than the SLT/286, making the SLT 386s/20 Compaq's most powerful laptop to date. It ships with either a 120MB 19-millisecond hard disk or a 60MB disk. It has 2MB RAM (expandable to 14MB), 4Kb cache memory, a 10-inch LCD display with 16-bit VGA, a 3.5-inch high-density floppy, and two expansion slots. Compaq's enhanced nickel cadmium battery promises 3 hours of computing. The SLT 386s/20 weighs 14 pounds and measures 4 by 13.5 by 8 inches (HWD).

Compaq's new 20-MHz SX-based system, the Deskpro 386s/20, is available without a hard disk, or with a 60MB or 120MB drive. This is a small footprint PC featuring VGA graphics via Compaq's Integrated Video Graphics System with its graphics accelerator, 2MB RAM (expandable to 16MB), a 4K cache, a 3.5-inch high-density floppy, four full-sized 16-bit expansion slots, and supports up to five internal storage devices.

List Price: Compaq SLT 386s/20, with 2MB RAM, 60MB hard disk, 1.44MB floppy disk drive, VGA, $6,799. Deskpro 386s/20, with 2MB RAM, 60MB hard disk, 1.44MB floppy disk drive, VGA, $4,499. Compaq Computer Corp., 20555 FM 149, P.O. Box 692000, Houston, TX 77269; (713) 370-0670.

CIRCLE 444 ON READER SERVICE CARD

CompuAdd 316SL

CompuAdd splashes into the laptop pond with its first portable, a 16-MHz 386SX. Measuring 2.4 by 12.7 by 12.4 inches, the 316SL weighs 11.5 pounds, complete with 2MB RAM (expandable to 6MB), a 40MB hard disk, a 3.5-inch high-density floppy drive, an 85-key keyboard, and a 10-inch backlit VGA (LCD). CompuAdd promises 3 hours of battery life on the 316SL, which supports an external VGA monitor and keyboard. *Windows* 3.0 and *LapLink* software are also included.

List Price: CompuAdd 316SL with 2MB RAM, 40MB hard disk, 1.4MB 3.5-inch floppy disk, backlit VGA LCD, *Windows* 3.0, *LapLink*, DOS 4.01, $2,895. CompuAdd Corp., 12303 Technology Blvd., Austin, TX 78727; (512) 250-1489.

CIRCLE 446 ON READER SERVICE CARD

DATA LP/320

DataWorld's new 386 20-MHz laptop is priced below many SX portables. Its features include from 1MB to 8MB RAM on the motherboard, 40MB or 80MB hard disk, a 10-inch VGA backlit LCD, 3.5-inch 1.44MB floppy disk drive, 81-key keyboard, one half-length 8- or 16-bit expansion slot, and a removable 4-hour nickel cadmium battery. The DATA LP/320 also supports an external 5.25-inch floppy drive or tape unit, an external VGA monitor, and a full-sized keyboard. It weighs 19 pounds with battery adapter and measures 3.9 by 12.6 by 14.3 inches (HWD).

List Price: DATA LP/320 with 1MB RAM, 40MB hard disk, 1.44MB floppy disk drive, VGA, $2,595. DOS 3.3 or 4.01, $100. DataWorld Inc., 3733 San Gabriel River Pkwy., Pico Rivera, CA 90660-1495; (800) 736-3282, (213) 695-3777.

CIRCLE 446 ON READER SERVICE CARD

GRiD 1810 Notebook

GRiD Systems Corp. touts the GRiD 1810 as the "first notebook with a removable hard disk drive." As of now, the Prairie Tek hard disks support only other GRiD 1810s, but this fall GRiD will offer the Desktop Receiver, which will allow users to insert the hard disk into GRiD and Tandy desktop computers. Eventually the Desktop Receiver will be adapted for use in any DOS-based PC. Measuring 1.8 by 12 by 10 inches (HWD) and weighing 6 pounds, the no-floppy GRiD 1810 features a 10-MHz V-20 processor, 1MB RAM (expandable to 2MB), a 10-inch EGA display, a 20MB removable hard disk, an 81-key keyboard, one parallel and one serial port, ROM-based *LapLink* communication

CONTINUES ON PAGE 54

The 6-pound GRiD 1810 notebook features a 20MB removable Prairie Tek hard disk.

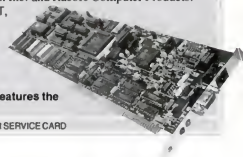
PHOTOGRAPHY: THOM O'CONNOR

HOT PROSPECT

16Mb TOKEN-RING ADAPTERS BRING SUBSTANTIAL SPEED GAIN TO NETWORK LANS

With the release of Texas Instrument's 16-megabit Token-Ring Falcon chip, the Thomas-Conrad Corp. announced two new network adapters. The TC4045 16/4 Token Ring Adapter/AT and the TC4046 16/4 Token Ring Adapter/MC were designed for use on AT and Micro Channel computers, respectively. Both adapters have optional bus-mastering capabilities, run at either 16- or 4-Mbps (megabits per second), and come standard with 128K of RAM expandable to 2MB. Furthermore, each adapter features an on-board Texas Instruments processor designed to help free up the CPU by handling many of the MAC- and LLC-layer protocol instructions. Other networking manufacturers announcing 16Mb Token-Ring adapters include Proteon Inc. and Racore Computer Products.

List Price: TC4045 16/4 Token Ring Adapter/AT, $849; TC4046 16/4 Token Ring Adapter/MC, $875; TC4050-16 MAU, $985. Thomas-Conrad Corp., 1908-R Kramer Ln., Austin, TX 78758; (800) 332-8683, (512) 836-1935.



Thomas-Conrad's new Token-Ring adapter features the new Texas Instruments 16Mb Falcon chip.

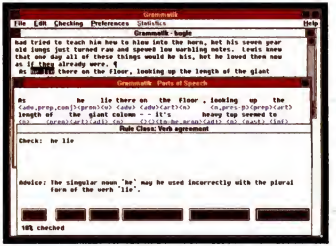
CIRCLE 443 ON READER SERVICE CARD

New & Improved

IMPROVED

***Norton Backup*, Version 1.1**—*Backup* moves forward with enhanced features such as improved speed, more efficient data compression, and a new command line restore feature. Version 1.1 adds expanded software and hardware compatibility including support for DR-DOS, *DESQview*, the OS/2 compatibility box, systems with modified international country codes, and network backup capability. The program also claims to work with more disk controllers, hard disk drives and BIOS combinations. Norton has begun shipping free upgrades to registered users; first-time buyers of *Norton Backup* will pay $149. Peter Norton Computing is in Santa Monica, Calif., and can be reached at (213) 319-2000.

Grammatik Windows—Reference Software's grammar utility now does *Windows*. *Grammatik Windows* takes advantage of the *Windows* 3.0 environment. In one window *Grammatik* can break a sentence into parts of speech while it searches for syntax errors in another. More importantly, in addition to the 38 word processors it already supports, the program now allows users to work directly with *Microsoft Word for Windows*, *Ami* and *Ami Professional* files. *Grammatik Windows* retails for $99 ($245 for five users), and Reference Software offers a $39 upgrade for registered users of *Grammatik III* and *IV*. You can reach Reference Software in San Francisco, Calif., at (800) 872-9933 or (415) 541-0509.



***Grammatik* breaks down sentence structure and shows grammatical inconsistencies in distinct windows.**

***Who-What-When*, Version 2.0**—Chronos Software's personal information manager adds three hotkeys to let users toggle to other programs. This allows users to replace *Who-What-When*'s memo pad with a word processor, the calculator with a spreadsheet, or its auto dialer with an e-mail package. Version 2.0 also enables users to print compressed reports (onto special paper provided by Chronos) that fit into popular planner-organizers such as Day Timer, Day Runner and Filofax. Other enhancements include: Group Names that

CONTINUES ON PAGE 56

CONTINUED FROM PAGE 53

software, and a removable 2-hour nickel cadmium battery. Users can choose between either a backlit or reflective LCD. The 1810 supports GRiD's 2,400-bit-per-second (bps) MNP Level 5 internal modem.

List Price: GRiD 1810 with 1MB RAM, 20MB hard drive, EGA, *LapLink*, and DOS 3.3, $2,895. GRiD Systems Corp., 47211 Lakeview Blvd., Fremont, CA 94538; (415) 656-4700.

CIRCLE 447 ON READER SERVICE CARD

Toshiba Laptops Get Error-Correcting, Fax Modems

Touchbase Systems has introduced the WorldPort 2496i-TD and 2405i-TD internal modems for Toshiba laptop computers. Both modems offer full Bell and CCITT compatibility, and fit Toshiba's T1000SE, T1000XE, T1200, T1200XE, T1600, T3100SX, and T3200SX laptops. The 2496i-TD combines a 9,600-bps Group III facsimile functions with a 2,400-bps modem on a single card. It automatically routes incoming and outgoing fax and data calls and can send group broadcasts in the background. The 2,400-bps WorldPort 2405i-TD supports MNP Level 5 error correction and data compression with an effective throughput of up to 4,800 bps.

List Price: WorldPort 2496i-TD, $599; 2405i-TD, $399. Touchbase Systems Inc., 160 Laurel Ave., Northport, NY 11768; (516) 261-0423.

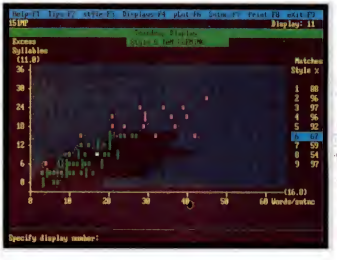
CIRCLE 448 ON READER SERVICE CARD

New Writing Style Replicator Helps Users Find Their Corporate Voice

NEW

If your company requires a consistent writing style of its own, the *Corporate Voice* will help you find and keep it. The *Corporate Voice* is a writing style replicator that creates a set of computer style models from your best letters, memos, proposals, and reports. You can compare any new piece of writing to the appropriate model, and the program shows you how your vocabulary and structure deviates from the desired style. Included with the package are 15 preprogrammed styles that will help you if you don't already have a style of your own. The *Corporate Voice* is network compatible and works with all DOS-compatible word processors.

CONTINUES ON PAGE 59



The tear drop diagram in *Corporate Voice* shows how text deviates from a desired model. A looser tear drop shows more complex text. We compared a *PC Magazine* article to an Ian Fleming novel. This gave us a 67 percent match, telling us to keep working on it.

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Computers, FCC Class A, Class B, and You — or When is it better to get a B than an A?

You need to know the difference between computers that meet the FCC class B radio frequency emissions standards and those that meet only the Class A standards.

Computers emit radio signals in their operation. Because these signals may cause interference to radio and television reception, the marketing and the use of computers is regulated by the Federal Communications Commission. Under federal rules, computer users are responsible for remedying interference, including interference in neighboring homes.

Computers certified by the FCC as meeting the Class B standard are less likely to cause interference to radio and TV reception than those that have been verified by the manufacturer or importer to the Class A standards. Only Class B certified computers may be advertised, sold, or leased for use in residences. A similar regulatory program applies in Canada.

Buyers seeking computers for use in homes (including offices at home) should shop for computers and peripherals which have been Class B certified. These devices carry a label with an FCC ID number. Both new and used Class A verified devices may be sold only for use in commercial and industrial locations. Signals from computers are more likely to be masked by electrical noise from other equipment in such an environment. These areas are also likely to have fewer radios and TVs. Accordingly, equipment marketed only for use in these locations may meet the less rigorous Class A standard. Class B certified equipment may be marketed for use in residences as well as commercial and industrial locations.

As you shop for a computer for use in your home, look for the FCC classification in the specifications or ask your vendor to recommend only machines that have been certified to the Class B limits. TV viewers and radio listeners in your home and in neighboring homes will be glad you did.

New&Improved

IMPROVED

CONTINUED FROM PAGE 54

allow you to update the calendars of all individual group members; Cardfile Categories that act as a Rolodex, where each cardfile can be linked to an unlimited number of categories; an intelligent date feature that recognizes "ten days from now" or "next Tuesday;" an Interactive Office Calendar that checks for conflicts in all related calendars; unlimited milestones for projects; and password protection. Registered users can upgrade for $79. *Who-What-When* sells for $295, and is available from Chronos Software in San Francisco, Calif., at (415) 626-4244.

***Brainstorm*, Version 2.0**—Mustang Software's network think tank software has expanded its capabilities by adding support for private discussions and invitations. With the Invitation function, users are invited to join in on a topic discussion. Users select only the topics that interest them. So they can follow the discussion as it develops, users see all messages already within that topic. In a Private discussion, the topic author can include or exclude anyone. "By Request" allows the topic author to select brainstorming members based on their responses to the initial invitation. *Brainstorm* is $349 for 25 users, or $699 for unlimited users. Upgrades are available for $50. Contact Mustang Software Inc. in Bakersfield, Calif., at (805) 395-0223.

***NewViews*, Version 1.13**—Q.W.Page Associates' visual accounting package increases speed while offering better protection against data damage. *NewViews* now keeps all data in one file instead of nine; in this way it is impossible to damage a set of books by mixing up files. To further insure data integrity, checksums have been added to all data entries to monitor. With its streamlined file structure and buffered DOS File Allocation Table as well as expanded memory, Version 1.13 promises significant speed gains. A new user interface shell and tutorial have also been added to make operations easier. The shell lets users select accounting and/or DOS operations merely by choosing select boxes. *NewViews* 1.13 retails for $995 with a $99 upgrade available to registered users. Users must update to Version 1.13 to remain qualified for unlimited free customer support. Contact Q.W.Page in Toronto, Canada, at (416) 923-4567.

***Org Plus*, Version 5.0**—Banner Blue's popular organizational chartmaker now offers 12 fonts, including OnePage, which allows users to fit up to five times as much data on a single page. The fonts require no installation and download automatically into LaserJet printers and compatibles. *Org Plus* 5.0 also takes advantage of font cartridges for LaserJets and compatibles. Furthermore, nine new chart styles have been added. *Org Plus* retails for $99.95, and existing users can upgrade for $25. Contact Banner Blue in Fremont, Calif., at (415) 794-6850.

***Quick Schedule Plus*, Version 3.1**—Power Up! Software Corp. has added 3 new fonts to its scheduler. In addition to the new high-quality Times Roman and Helvetica fonts, Power Up! now offers a miniature font that allows users to print as small as 60 characters per inch on a laser printer and 37 cpi on 24-pin dot-matrix printers. Version 3.1 incorporates 11 new task symbols and 13 new task bar styles designed for easy visual identifications of key activities. Milestones are more visible and can be annotated with up to 20 lines per task. The retail price for *Quick Schedule Plus* is $84.95; upgrades cost $20. Contact Power Up! Software Corp. in San Mateo, Calif., at (800) 851-2917, or (415) 345-5900.

***Pixie*, Version 2.0**—Zenographics announces improved speed and more flexibility for *Pixie* users. Version 2.0 implements a selective redraw function that updates only the area of the screen being affected by a change. Pixie's enhanced charting now includes: error bar charts, scatter charts with trend lines, dual y-axes charts, the option to display more charts simultaneously, increased chart views, and new bullet styles. Other enhancements include Bitstream Fontware "on-the-fly" scalable fonts, a spell-checker, support for dynamic data exchange (DDE), a slide show feature, and improved access to *Windows* system functions like Printer Setup. *Pixie 2.0* retails for $295, and registered users can upgrade their software for $60. Zenographics is located in Irvine, Calif., at (714) 851-6352.

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CIRCLE 114 ON READER SERVICE CARD

New & Improved

Corporate Voice

CONTINUED FROM PAGE 54

List Price: The *Corporate Voice*, $119.95.
Requires: 256K RAM (512K and hard disk recommended) DOS 2.0 or later.
Scandinavian PC Systems Inc., 51 Monroe St., #1101, Rockville, MD 20850; (800) 288-SCAN, (301) 294-7450.

CIRCLE 622 ON READER SERVICE CARD

Beyond 640 Breaks Lotus Release 2's Memory Limits

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Lotus 1-2-3, Release 2 users can now go *Beyond 640*. By changing the way *1-2-3* stores information and by accessing as much as 4MB expanded memory, *Beyond 640* by Intex Solutions Inc. lets *Lotus 1-2-3* users create spreadsheets of massive proportions. *Beyond 640* works with *Lotus 1-2-3*, Release 2.0, 2.01, and 2.2.
List Price: *Beyond 640*, $95 plus $5 shipping.
Requires: LIM 3.2 or 4.0 expanded memory, DOS 2.0 or later. Intex Solutions Inc., 161 Highland Ave., Needham, MA 02194; (617) 449-6222.

CIRCLE 449 ON READER SERVICE CARD

ComSystem Offers Single Solution to LAN Communications

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List Price: ComSystem, $6,995. Gateway Communications Inc., 2941 Alton Ave., Irvine, CA 92714; (800) 367-6555, (714) 553-1555.

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CIRCLE 495 ON READER SERVICE CARD

edited by
Lori Grunin

Read Only

Reviews of the Latest Books for the PC User

The A-B-Cs of C++

If you're a C programmer eying object-oriented programming, chances are you're looking at C++, a successor to C that incorporates object-oriented extensions. We've picked some of the best of the recently released C++ books to help you decide which C++ primer is right for you.

■ *The Complete C++ Primer*
by Keith Weiskamp and Bryan Flamig
Academic Press, $45

For a well-written, effectively illustrated tutorial on C++, *The Complete C++ Primer* is the one to buy—especially for C programmers looking to make the switch to C++.

The book opens with a well-designed program demonstrating a string class with member functions, an overloaded operator, a friend function, and a constructor. From there the book covers topics ranging from an introduction to object-oriented programming to C++ stream I/O and record-oriented file I/O. Given the book's rather outrageous price ($45), solutions to the end-of-chapter exercises are a disappointing omission.

***The Complete C++ Primer* brings C wizards up to speed on object-orientation.**

The presentation, though, is excellent, and particularly effective if you're already a C whiz; the authors highlight the differences in method, style, and content between C and C++, and various graphics help demonstrate the "superset" nature of C++. Changes unique to C++ 2.0 appear in an appendix.

Academic Press, 1250 Sixth Ave., San Diego, CA 92101; (800) 321-5068. ISBN: 0-12-742687-6.

CIRCLE **633** ON READER SERVICE CARD

■ *Using C++*
by Bruce Eckel
Osborne/McGraw-Hill, $24.95

This huge book contains twelve chapters and three appendices, including excellent chapters on "Arguments and Return Values" and "Writing Extensible Programs in C++."

The first part of the book discusses classes, pointers, references, and overloading; the second deals extensively with C++ as an object-oriented language and covers more difficult topics, such as code reuse, extensibility, and dynamic object creation.

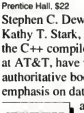
The book suffers from a nearly complete lack of illustrations, but it's heavy with commented code and includes several complete example programs ranging from a command line option interpreter to a simple CAD package that uses graphics and supports the mouse. As with Weiskamp and Flamig, treatment of C++ 2.0 is left to an appendix. While Eckel's coverage is in-depth and extensive, his approach seems scattered—but it's still a great value and a worthy addition to your library.

Osborne/McGraw-Hill, 2600 10th St. Berkeley, CA 94710; (800) 227-0900. ISBN: 0-07-881522-3.

CIRCLE **634** ON READER SERVICE CARD

■ *Programming in C++*
by Stephen C. Dewhurst and Kathy T. Stark
Prentice Hall, $22

Stephen C. Dewhurst and Kathy T. Stark, members of the C++ compiler design team at AT&T, have written an authoritative book with an emphasis on data abstraction and object-oriented programming as they apply to C++.



The book is effectively organized and includes end-of-chapter exercises with answers.

Packed tightly into its 233 pages are great sections on designing objects and inheritance, as well as a chapter devoted to building extensible libraries. Since deciding what should be an object can be one of the most difficult tasks, Dewhurst and Stark go beyond language features to include guidelines for designing objects and using inheritance as a design tool. This is the only book of the three devised specifically with C++ 2.0 in mind.

Prentice Hall Order Dept., 200 Old Tappan Rd., Old Tappan, NJ 07675; (201) 767-5937. ISBN: 0-13-723156-3

CIRCLE **635** ON READER SERVICE CARD

All three books are well written and worthwhile. Weiskamp and Flamig offer the easiest transition from C to C++; theirs is the best choice for a first book on C++. Eckel's book is code intensive and a good value, while Dewhurst and Stark offer up-to-date coverage of C++ 2.0 and object-oriented design issues.

—Salvatore P. Ricciardi ■

A VIDEO C++ PRIMER

■ *C++ Video Tutorial*
Zortech Inc., $499.95

A thorough and well-presented alternative to a book is Zortech's *C++ Video Tutorial*, which consists of a set of 32 tutorials on six videotapes, a workbook, and an optional copy of Zortech's C++ compiler.

I particularly like the clarity with which the presentation differentiates between ANSI-C, C++ 1.2, and C++ 2.0. The course comes with on-disk code examples, and is best taken with a C++-equipped system nearby for the end-of-lesson exercises. Although the examples are guaranteed to work only with Zortech C++, I had no difficulty compiling many of them with Borland's Turbo C++.

At $499.95, the tapes are more expensive than a book, but it's worth it if you watch them and do the exercises diligently—the same material taught in a classroom setting would cost much more, and this way you can move at your own pace.

—Salvatore P. Ricciardi

Zortech, Inc., 4-C Gill St., Woburn, MA 01801; (800) 848-8408.

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by Gus Venditto

Pipeline

A Look at the Trends Shaping the Personal Computer Market

A Work-in-Progress, OS/2 Is Slimming Down and Working on Speed

Just as *Microsoft Windows* 3.0 has begun to bask in the glory of success, news about improvements to OS/2 are helping to clarify the long-term future for graphical interfaces on PCs.

At the recent New York City computer fair, PC Expo, IBM gave a "technology demonstration" of an as-yet unnamed and unannounced version of OS/2.

Showing a product while not announcing it may seem like an exercise in semantical subterfuge, but it's IBM's way of assuring the world that programmers are hard at work on improving the operating system without forcing IBM to commit to a delivery date and the specific features that will be ready when it does ship.

Also, IBM wanted to squelch rumors that OS/2 would be split into a main operating system and a second, smaller version that was dubbed "OS/2 Lite."

The technology demo was a way for IBM to affirm that it intends to improve the current version of OS/2 as an upgrade, not as a spinoff, and that it has heard loud and clear that OS/2 requires far too much memory.

This unfinished version could run two OS/2 applications on a 2MB machine (about half what would be needed today), and it performed most tasks roughly 25 to 30 percent faster.

Even more striking was the seamless integration of *Adobe Type Manager (ATM)*, software that greatly enhances the quality of screen fonts while providing a true WYSIWYG graphic display. It appears likely that IBM will bundle *ATM* with OS/2; *ATM*'s been a smash hit on the Mac and will be available for *Windows* 3.0 later this year, probably in the fall.

ATM will provide screen

CONTINUES ON PAGE 64

TOP TEN SELLERS — A Five-Week History

Windows 3.0 is for real. After six weeks on sale, it has not dropped below the number two position. *Windows* applications like *CorelDRAW, Word for Windows*, and *Microsoft Excel* also got a shot in the arm, propelling them into the top 20 in recent weeks.

Meanwhile, Borland continues to make gains in the spreadsheet market. *Quattro Pro* ranked 15th this week, and the *Quattro Competitive Upgrade* was number 20.

READING THE CHART

The Top Ten Sellers list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending July 7. The chart that appears to the left of each program name shows how the program's sales ranked each week for the last five weeks. The hash marks at the bottom of each chart represent each of those five weeks, beginning with the week of June 4. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and can not be interpreted as a complete picture of the entire software market.

Sales information compiled by Ingram-Micro D and PC Connection Inc.

Rankings are based on a net total of copies shipped to retailers; returns are subtracted from gross shipments.

Pipeline

CONTINUED FROM PAGE 63

fonts for most laser printers, whether they're PostScript-based or HP-compatible, and it's likely the OS/2 version will provide screen fonts for the fonts that are resident in HP LaserJets; plus, there'll be a handful of Type 1 downloadable typefaces. (The question of whether Adobe's or Microsoft's TrueType font management scheme will prevail in OS/2 is far from resolved, and will likely be a subject for analysis later in the year.)

IBM wanted to squelch rumors that OS/2 would be split into a main operating system and a second version called "OS/2 Lite."

In short, the technology demo was a clear signal from IBM that OS/2 will evolve and will strive to become as exciting as *Windows* 3.0 is today.

That shouldn't be seen as a confusing direction: Microsoft is determined to make *Windows*'s executable files run unchanged under OS/2 in the future. And every *Windows* software developer knows that it will need to migrate to OS/2 eventually.

So *Windows*' position as a way station on the road to a faster, slimmer OS/2 seems clearer than ever.

IBM Gets Serious about Multimedia Development

IBM is saying that multimedia will be to the '90s what the personal computer was to the '80s, and has just created a corporate division to develop integrated audio/video products.

IBM's M:Motion Board (reviewed in First Looks this issue) and the Audio-Visual Connection are the type of products that this division will be developing. The PS/1 home computer (reviewed last issue) is expected to be a multimedia machine, after the MIDI option ships in September.

No specific projects for the division were unveiled, though IBM vice president Jim Cannavino recently said that connections between the VCR and PCs in the home seemed like a logical next step.

Disney Hopes to Sprinkle its Magic on Software

You knew it was only a matter of time.

Walt Disney Co. has decided the climate is finally right to bring Mickey Mouse and the other cartoon characters to the PC. Disney said it's basing its move on its own estimate that there are 1.3 million households in the United States that have both a PC and at least one child between the ages of 2 and 5.

The company is also aware, no doubt, that the leading PC entertainment software companies are enjoying steady growth; in 1989, Electronic Arts had revenues of $66 million and Broderbund took in $51 million.

Disney's initial programs will sell in the neighborhood of $40 and will be linked to a new sound device called the Sound Source that plugs into a PC port. Videos that entice parents to buy the games will also be sold for $5.95; the cost of the tape can be applied toward the purchase price of the software.

In these programs the Disney characters appear on the screen while they talk through the Sound Source, guiding youngsters through simple exercises on the keyboard.

The Next Version of DOS Will Emphasize RAM Efficiency

Even with OS/2 development in high gear, Microsoft still keeps a team of programmers devoted to improving DOS.

Look for a major upgrade sometime this fall that will increase the amount of RAM available to programs, thanks to VCPI (Virtual Control Program Interface) memory-management techniques that will store device drivers and a large portion of the code for internal DOS commands up in high memory on 286 and 386 PCs.

As a result of this upgrade, it will not be uncommon to have more than 620K of usable DOS memory after loading a typical assortment of TSRs and network drivers.

The next DOS will also enhance the graphic tree structure introduced with Version 4.0, while keeping the character-based C:\ prompt design as an option. And, context-sensitive help should become available directly from the command line. The current plan is to allow a user to enter a DOS command followed by a question mark at any DOS prompt to get help.

Other expected improvements include directory renaming commands and an editable command line with a buffer, similar to the features in the *PC Magazine* utility ALIAS.

The scheme for increasing available program memory is expected to work when running DOS under OS/2 or *Windows*, and should not conflict at all with the DOS extender technology now used by Lotus 1-2-3, Version 3.0. ■

MAGNET SURVEY

Last November we surveyed PC MagNet callers about desktop publishing. Since then there have been some interesting changes. "Newsletters" remain the most common application for DTP software, but "reports and proposals" rose from last place to second, and "forms" rose from insignificance to a job that half the users are now doing. 1,330 people responded to this new survey.

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—InfoWorld, May 8, 1989

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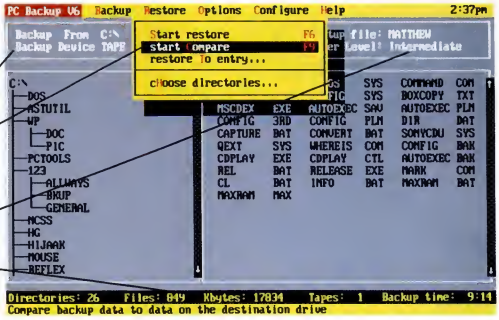

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—PC Magazine, Jan. 16, 1990

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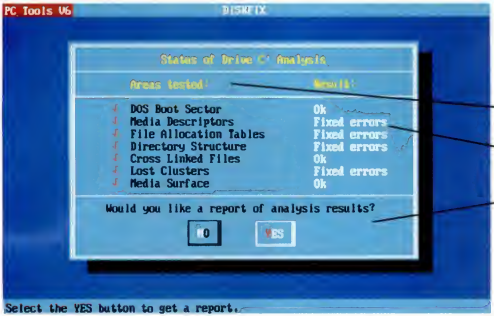
ugh for advanced users
h for beginners."

Ed Mendelson, PC Magazine "Best of 1989 Awards," January 16, 1990



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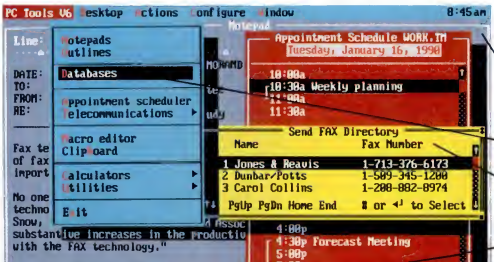

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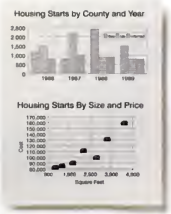

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Bill Machrone

A Practically Perfect PC

Anyone can be a PC manufacturer, but it takes something else to be a good one. It's equally difficult to be a good customer.

Greg Herrick, the president of Zeos International, was quoted recently as saying, "Anyone with a screwdriver can be a PC manufacturer." That's either one of the dumbest or one of the cagiest things I've ever heard anyone say about computers. Let's think a minute about what we can read into this quote.

Sure, you can buy a bunch of off-the-shelf components, slap them together, and put a zoomy label on it. But the resulting machine likely will be a mediocre set of compromises that lacks distinguishing features, user benefits, or even a competitive price. Building a PC that people really want to buy takes careful selection of product features, matching of components, and fine-tuning. I think Herrick wanted to throw potential competitors off the scent by making the PC business sound a whole lot easier than in fact it really is.

Building a PC certainly doesn't qualify as a black art, but there's more to it than meets the eye. I recently toured the manufacturing facility of another direct marketer, Swan Technologies. While I was there, I chatted with the engineers (I was attracted to their work area by the shelves overflowing with back issues of *PC Magazine*). They gave me an engineer's-eye view of the process that begins when the "finished" motherboard and BIOS arrive. It's a time-consuming, exacting process of maximizing performance, testing for compatibility, and resolving hardware and software conflicts.

Swan's engineers clearly demonstrated that the time of building PCs with whatever parts are cheapest is over. The compatibility issues simply take too long to resolve. Changing the components too frequently also raises questions about the manufacturer's ability to service and support the machine.

Then there's the ugly specter of FCC recertification. Changing the major components in the machine changes its RF emissions characteristics. So the FCC requires that the machine be retested. That adds thousands of dollars to the cost and a couple of months to the date you can deliver the final product to a customer.

I've focused on the direct marketers here because in general they're much faster on their feet than the retail manufacturers. The latter build computers for the channel; the former build them for the customer. Those who manufacture for the retail channel have to build machines that the distributors and dealers will buy, and retail manufacturers must build their machines in volume. The direct marketer takes your order, builds a machine according to your request, and ships it to you. So for the direct marketers, there is always the temptation to improve the next machine out the door with some small change or another to bring it a step closer to the state of the art.

HANDCUFFED BY THE STANDARD

No matter how much PC manufacturers tweak their products, ultimately they're limited by the IBM standard. The choices made in the first PC still dictate much of what manufacturers can do. DOS and application software are the other great levelers. How, then, do you distinguish one machine from the rest? How do you make a good selection? Even starting from such similar points, manufacturers can still take machines in many different directions, tailoring them as file servers, graphics workstations, workaday machines, or hyperthyroid performance monsters. Look for innovation within the standard—compatibility plus originality, at the price you want to pay, with the features you need and the ones you're going to need.

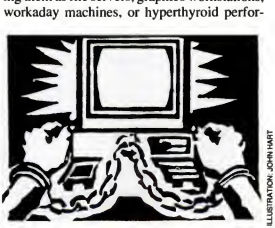

ILLUSTRATION: JOHN HART

Interestingly, manufacturers take compatibility for granted; customers assume it to be conditional at best. In a recent focus group conducted by *PC Magazine*, directors and vice presidents of MIS agreed that "nothing is really compatible with IBM." They're wrong,

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Bill Machrone

but that's the perception. These executives typically do not choose the brand of PC, and frankly, they have no idea what they're talking about technically. But you can't blame them. Compatibility has come a long way over the years, but they've heard all the old horror stories.

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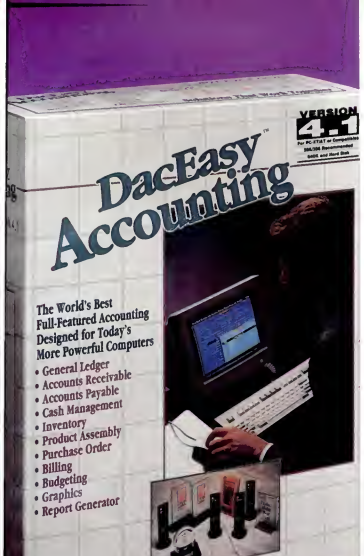
Pay only for the performance that counts. Performance is an important ingredient in today's machines, but get the right features for the work you'll be doing. Additional system memory increases total performance at all levels. It's also the least expensive means of getting the most performance out of a system. The memory can be used for disk caching, RAM disks, shadowing BIOS code, accommodating new versions of DOS and *Windows*, and giving your users the flexibility to move up to OS/2 when it's time.

Most machines will never need caching disk controllers, graphics coprocessors, and math chips. The few that do can be upgraded at any time. Buy a 386SX, 386, or 486. The staying power is in the instruction set. Be careful, however, not to make the machines you buy too generic. A 486 machine, for example, can be preconfigured with a large hard disk, monochrome VGA, and an internal UPS. It says "file server." The same machine can be configured with a dedicated mouse port, a high-performance graphics card, and a 16- or 19-inch monitor. Now it's telling you that it's a graphics workstation. If you try to convert one into the other, you wind up with parts on the shelf or useless components in the box.

Work with your accountants. The old depreciation rules never heard of today's computer technology. If a machine is a year old, it's obsolescent. It's not obsolete, but it can't compete with this year's PCs in terms of levels of integration and price performance. Look for every opportunity to pass along last year's machine to someone new who can use its power. Acquire the state of the art for those who'll benefit most from it. Buy up the technology curve, not down the price curve.

Herrick should have said, "Anyone with a screwdriver and a brain can be a PC manufacturer." The kind of machine that can be built with just a screwdriver isn't worth building. Or buying. ■



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- PC Magazine, April 10, 1990

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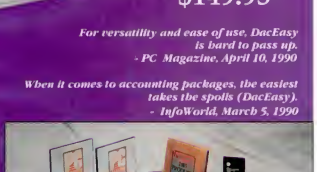

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John C. Dvorak

Crazy Mistakes Part III

Our columnist thought he had seen everything in the PC industry—until he was overwhelmed by a flying mouse.

I knew I had to do the third edition of Crazy Mistakes after what happened while I was showing a new clerk how to use a Macintosh. Thinking it would be an easy machine to learn, I turned around to see her waving the mouse in the air in a vain attempt to get the cursor to move. "Wow, I actually saw this for myself!" I was stunned.

After showing her how to use the mouse she began work and later said, "Okay, I'm done. Now I just turn it off and it saves everything automatically, right?" I frantically jumped for her as she motioned to shut off the machine. The "saves automatically" notion was a new one for me.

So onward to more Crazy Mistakes submitted by readers.

Some of the daily idiocies are committed by the hapless MIS department, where there still exist a few Neanderthals who know little about PCs. This is a problem for the sharp computer-literate Kelly Girl or temp, such as Animesh Karna. She writes, "Someone was running an application. They get a message, 'Error Reading Drive C: Abort, Retry, Ignore, Fail?' They run, in a panic, to the MIS person, who adjusts his tie and walks up to the machine. Next thing I know, they're running around yelling 'Virus Attack! Virus Attack!' So I walk over to the machine with my copy of *PC-Tools*. (Back then, I always carried around a few key disks for just such an emergency.) I run COMPRESS, mark the bad cluster, and whisper to everyone 'No virus . . . it was just one of those things.' Those MIS people hated me."

Another *Abort, Retry, Fail?* story comes from Arthur Tan who tells me of the woman with the "defective disk drive": *I had a student who was working with a two-floppy drive PC and kept asking for replacements for her diskettes because they were "defective." We got suspicious when she kept coming back and asked her to show us what was wrong. She types "DIR," and sure enough, there was "Abort, Retry, Fail?" She pulls out the diskette from* ***between*** *the drives and says "See, it's defective."*

Then there's the Crazy Mistake now common to more than a few companies utilizing 1-900 phone technical support lines. Dee Dee Walsh at Buttonware says that plenty of people calling its 900 line are misdialing. They were really trying to call one of those raunchy sex lines. One woman caller was adamant when another woman answered; she insisted on speaking to a man for who knows what!?

Credit Greg Andrews for pointing out what has to be a common blunder: *My first experiences as an in-house PC support tech were teaching our receptionists (a new one every six weeks) to use* WordStar 3.3. *The computer was a dual-floppy clone, so I taught them to use the disk in the B: drive to hold all their letters and memos. The disk in the A: drive just had the DOS boot files and the* WordStar *program and overlays. One Monday, Receptionist #3 called me up. "The computer is broken, Greg," she said. So I went down with my diagnostic disks to see what had zapped her computer. Sure enough, it would go haywire just as soon as it started to boot. I popped my own DOS disk in and hey, it booted up no problem at all. "Wow, you fixed it!" she cheered. "Must've had a bad disk or something."*

ILLUSTRATION: JOHN HART

Back on my computer, I brought up the directory of her disk. COMMAND.BAK? Oh no, don't tell me. A quick call confirmed that, yes, she did. She had tried to edit COMMAND.COM. "I just wanted to see what it was. It looked strange," she said. "Yes, that's a DOS file, and WordStar *can't edit DOS files." I explained "Don't do that!"*

When she received her disk back, COMMAND.COM was a hidden file.

That's the Dvorak TIP OF THE MONTH!

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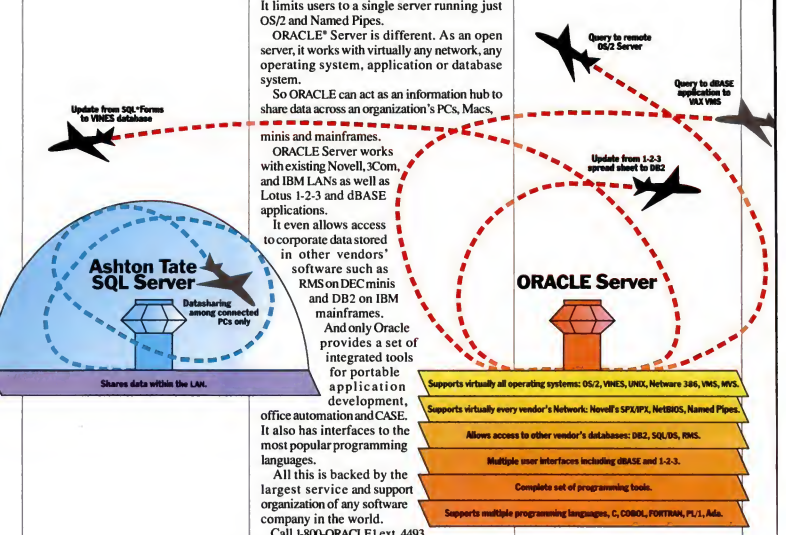

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John C.
Dvorak

Inside Track

Spring Comdex has come and gone in Atlanta. The show was highlighted by more song and dance acts than ever before. There were singing monitors, a **Three Stooges** look-alike act, and even a real-life Bob Denver for who knows what reason.

Overall, the show was a big success. Packed. This was augmented by beautiful June, Atlanta weather. **IBM,** which supposedly eschewed the show in favor of PC Expo, was actually there in a small way. Specifically it was in the Soft-Kat booth, showing a rather nice CD-ROM disk called *Mammals*. Using standard CD-ROM technology, proprietary compression, and some other **tricks,** *Mammals* offers full animation. Soft-Kat will sell the disk, which is essentially an encyclopedia of mammals, primarily to schools. It was a **great** use of the technology, no kidding. Call them in Chatsworth, California, at (818) 700-9000.

The most **impressive exhibitor** at the show was **Sharp Electronics.** Sharp, a perpetual also-ran in the industry, is making **a big move** with some hot new technologies and the niftiest laptop of the year.

Sharp was at Atlanta Comdex in force with dozens of things that impressed me. The first was its 4-pound 12-MHz 286 laptop with VGA paper-white LCD and a 20MB hard disk. Dubbed the PC-6220, it's priced at $3,995 (First Looks, June 12, 1990, *PC Magazine*). Everyone will be talking about this one.

Sharp also had one of the best thin film transistor (TFT) color displays at the show. It was beautiful and had a wide viewing angle. Sharp apparently wants to **regain the technological lead** in display technology that it held when the GRiD Compass appeared years ago sporting Sharp's yellow-on-black electroluminescent screen.

I have to note here that it looks as though **Hitachi,** which produced the first full-color display I ever saw on a laptop machine years ago, seems to be the first company actually shipping a full-size TFT color display. **Dolch Computer Systems** was proudly showing off its latest portable, which features Hitachi's display.

The color theme was apparent at the show, but particularly at the Sharp booth. There it was showing a nifty **color copier**—the CX-7500—and a **600-dpi full-color scanner,** the JX-600. While the scanner has a hefty $15,000 price tag, I found solace with the excellent 300-dpi, 24-bit JX-300 flatbed color scanner at $2,995. A nice product.

One mind-boggler from Sharp was its new **full-color fax** machine, which is currently available only in Japan. It looks like Sharp will price it in the $25,000 or higher range when it's made available here in the spring. Using a 14.4-kilobit-per-second modem and compression, it takes 5 to 10 minutes to send one of these full color faxes. While this device is expensive, I'm sure that an ad agency with offices all over the country will find it appealing. **The faxes are stunning.**

And finally Sharp had its innovative **LCD color one lens projector,** the $4,995 XG-1000. An **amazing product** that uses all new technology to project video images. While it doesn't do images justice when zoomed to 10-foot diameters, it is incredible at smaller sizes. This is one **hot item.** For all its new products and superb technologies, Sharp gets the **Dvorak Best Booth** at Comdex Award.

> For all its new products and superb technologies, Sharp gets the Dvorak Best Booth at Comdex Award.

Silicon Valley Rumors Dept.: The **hottest gossip** is over the rumored **386 clone chip** secretly developed by AMD. The news is that it runs, but nobody knows how fast. Rumor has it that AMD will be showing off the chip at Fall Comdex.

One gossip monger believes that much of the legal maneuvering between AMD and Intel is **because of this chip.** One interpretation of the original Intel contract is that AMD can continue to manufacture Intel chips under the agreement, which had a life of 10 years. Another interpretation says that any chips developed during the life of the agreement could be manufactured in perpetuum. So if AMD can theoretically clone the 386, it can **make a 386 chip forever** without fear of suits over microcode or whatever. At least that's one theory about the rush to clone the chip.

A more complex scenario has AMD ownership quitting while they're ahead and **selling the company to Sony,** possibly after merging with a company such as LSI Logic. If AMD can make a 386 legally, it would be valuable indeed since the 386 is the heart of all CISC design for the next decade.

Since Intel's creations are so hot (386, 386SX, and 486), many in the valley feel that there's no way Intel can meet next year's expected demand for its chips. Anyone who could legally second source the chip will be **flooded with orders.**

The unanswered question in all this palace intrigue is what the heck ever happened to NEC and its V-series line of microprocessors? Here's a company that showed up with V-20 and V-30 chips and then announced other fancy microprocessors years ago. It seemed as though it was on a path destined to challenge Intel. What happened?

The Forever Shrinking Disk Drive Dept.: The hottest disk drive manufacturer in the business is Conner Peripherals. The company will be rolling out at least an 80MB **2.5-inch** hard disk before the end of the year. We can expect **200 megabytes** to come out in this format within the next two years. Conner and Prairie Tech are the companies to watch in this arena. ■

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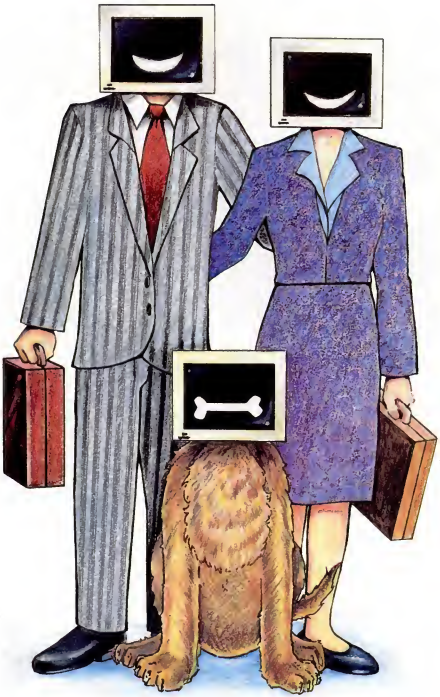

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Jim Seymour

Can Intel Walk the 286/386/486 Line?

With the superior design of the 486, and the 286 heading for home, will Intel find itself in a world without 386s? Could they afford it?

Elsewhere in this issue, you'll find our first large-scale comparative review of 486 PCs. As you'll discover, we found these first 25-MHz versions a little faster than speedy 386s, but not yet up to the real potential of Intel's 80486 chip.

You might also be interested in a fascinating bit of speculation that's going around the computer industry: Will the performance and success of the 80486 chip, combined with Intel's 286 bashing and the aggressive pricing and performance gains posted by other makers of 286s, turn this into a 286-486 world, with the 386 chip prematurely squeezed out? That would be very bad news for Intel.

The company has based much of its planning for the next few years on a vision in which the 80386 and the lower-cost 386SX chips dominate the PC industry. Succeeding 80x86 chips gradually would take over the top of the market, and the 386SX would wipe out the 286 at the bottom of the Intel-compatible market. According to plan, Intel would get the whole pie.

Intel can't afford to let the 386 market collapse for the next few years, since it has pegged so much on huge revenue streams from 386s. Yet, that very dependence may force Intel into pricing strategies which accelerate the 80386's demise.

A little history: When Intel introduced the 80286 chip, which first appeared in IBM's PC AT in August 1984, the microprocessor industry was built on the idea of second-sourcing. PC makers would never trust a single supplier, the wisdom went, so when you produced a chip which became a big hit, you quickly licensed other semiconductor companies to produce it as well, selling "mask rights" to them in return for royalty income.

PC vendors were thus assured of a constant supply of chips, no matter what natural or economic disasters might strike the chip developer, and semiconductor companies shared the wealth with each other.

That worked well at first with the 80286. Intel struck a highly publicized deal with Advanced Micro Devices. Together the two companies proclaimed the 286 the "partner-chip," and AMD began producing 80286s. Harris Semiconductor also licensed the 286.

A CHIP FOR ALL SEASONS

Intel, meanwhile, was readying the 80386. PC vendors assumed the 386 would also be second-sourced—if not by AMD, then by another prominent semiconductor fabricator.

But with the advent of the 386, Intel changed the rules. Intel said its economic strength and the geographical diversity of its 386 production "fabs" meant that second-sourcing was no longer needed.

The PC industry was skeptical but had little choice. Intel had the hot chip, which meant the hot hand.

AMD was enraged at being cut out of the profitable 386/486/586 path. Intel said it dropped AMD because its deal had been based on cross-licensing, but AMD had come up with nothing Intel wanted to license. AMD, of course, disputed that.

ILLUSTRATION: JOHN HART

AMD and Harris pushed ahead with faster 80286s. Soon 20-MHz 286s appeared, with 25-MHz units on the horizon. Harris pioneered fast, low-power CMOS 286s, ideal for laptops.

Intel, pushing the 386 as a chip for all seasons, began to disparage 286 design—its own design—in public, while heavily promoting the 80386s, especially the SX. Intel's red-X "graffiti" ads became famous. No one in the business could remember a chipmaker stabbing one of its own products in the back.

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AMD and Harris justifiably felt manipulated by Intel. They continued to advance the state of the 286 art and pushed prices down rapidly.

Intel's 386 series has become one of the all-time hits of the microprocessor industry. But with the 486, Intel now finds itself in a trap.

It must push the new chip as part of the continuing evolution of its line. Intel feels no pain when the 486 cannibalizes sales from its 386 line, because the 486 brings in more money. But pricing 386s is tricky. At the top, there has to be a decent spread between the 386 and the 486. At the bottom, the price of the SX should be cheap enough to squash 286s, without falling so low as to undermine the overall 386 revenue stream upon which Intel must rely.

If the 486 catches on too soon, and Intel's competitors drive the price of the 286 down a bit more while steadily increasing its performance, Intel faces that risk about which so much speculation is being heard: The huge, profitable 386 market disappears, with PCs split between low-end 286s and high-end 486s.

A HOME FOR THE 286?

Then into this mess leapt Microsoft's Bill Gates, three months ago, with his remarkable support for the 80286 as the chip for the coming home/multimedia PC market. After ripping the 286 for years, Gates has had a change of heart and now likes 10-MHz 286s as home PCs.

It's safe to guess that Intel's brass was more than a little unhappy with Chairman Bill's comments.

Finally, to confuse the market even more, IBM rolls out its new series of 286-based home PCs—intentional cripples, slotless to keep them out of the office, 386-less to keep them stuck in the 1980s.

What's going to happen?

My bet is on Intel—but only narrowly. Dave House, head of Intel's microprocessor division, is a smart manager. He understands pricing theory, and is certainly willing to wage price wars, if need be.

A division of the market between 286s and 486s seems unlikely, given the technical advantages and momentum of the 386 series, and Intel's savvy in the market. Yet it is just a bit weird out there right now.

What was it that the Chinese said about living in interesting times . . . ? ■

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William F.
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The Cost of Multimedia

Multimedia isn't going to revolutionize anything any time soon.

Multimedia seems well on its way to becoming one of the primary industry buzz words of 1990. Promotional videos featuring hypothetical multimedia systems "of the future" have become de rigeur. So many videos have appeared over the past year that it is a boom market for commercial video producers. From IBM, DEC, and (of course) Apple, right on down to the very smallest start-up companies, vendors are jumping on multimedia as the NEXT BIG THING. And with the breathless words that are being written and spoken about it, one might think that multimedia is about to burst onto the scene any minute now and dramatically change the way we use personal computers.

Don't hold your breath! Despite all the hype, it is going to be a long time before most of the stuff lumped under the rubric of multimedia is going to make much difference for the vast majority of personal computer users.

Multimedia is neither a well-defined nor unitary phenomenon. Not only does multimedia mean different things to different people, it generally amounts to a somewhat disjointed collection of software and hardware, video and audio at times obscurely connected with one another.

Optical disk, sophisticated 2-D and 3-D graphics, animation, music, voice recognition and synthesis, scanned documents, photographic images, television, object-oriented databases, digital signal processing, "virtual reality" systems, and even biofeedback input devices are among the items that may or may not turn up in any particular pundit's vision of multimedia.

In many ways, multimedia in 1990 bears a resemblance to "office automation" a decade earlier. The electronic typewriters, fax machines, dedicated word processors, and electronic mail systems that were touted ten years ago no more constituted a unified phenomenon than do the diverse elements of technology being touted as the "multimedia market" today.

In both cases the whole is less than the sum of its parts. By lumping together elements that are better and more accurately understood separately, multimedia invites hazy generalizing and muddled thinking. Appealing as that may be to supposed market researchers eager to sell their latest multimedia market reports, the catch-all term "multimedia" sheds little light on the underlying reality.

DEFINING MULTIMEDIA'S FUTURE

My intention is not to offer a "correct" definition of multimedia. Clearly the evolution of standards, unified products, and compatible peripherals that will change the way general PC users compute is unlikely to happen in the immediate future.

There are two reasons for the delay. The first is that business uses of multimedia aren't nearly as obvious as enthusiastic supporters believe them to be. This assertion may seem like heresy in an industry where enthusiasm for any new technology is the norm. One ought not assume that because something looks impressive, it must be useful. Simply because a few genuinely useful tasks can be done with a particular technology, there is no guarantee that its worth will be widespread.

ILLUSTRATION: JOHN HART

FileNet, for example, has been selling optical disk-based document management systems successfully for over half a decade. Combining scanned documents with a computer database has substantial benefits for the financial industry, certain government agencies, and elsewhere. These benefits are clearly realized in complex, highly structured, intensive, "heads down" clerical applications like insurance claims processing. They are not readily real-

William F. Zachmann

ized in less-structured, "general purpose" office activities.

Nifty as a demonstration of pictures or video on personal computers may be, it's not clear what the real benefits of such capabilities are on as widespread a basis as word processors or spreadsheets.

The second reason why multimedia will not make much of a difference to the majority of PC users is cost. Affordable hardware that supports multimedia applications on a wide scale won't be in place for several years. Of course, were the cost of such implementation negligible, there would be no obstacle to widespread adoption. The mere fact that multimedia capabilities were "nice to have" would be sufficient.

AN EXPENSIVE HABIT

Cost is the most compelling reason why multimedia isn't about to sweep the personal computer world. The many components necessary to handle sound, images, video, and so forth, require substantial resources. That adds up to significantly higher costs for multimedia-capable systems.

It's tempting to assume that continued technological improvements will make such systems affordable on a widespread basis soon, but it's likely that multimedia-capable systems will be substantially more expensive for some time.

Consider that the processor, memory, and storage requirements for OS/2 are thought by many to be a major obstacle to wider acceptance for OS/2. Consider the costs already incurred by many organizations simply to implement *Windows* 3.0 on a widespread basis, and neither makes significant provisions for multimedia.

Consider, too, that two years after its October 1988 introduction, Steve Jobs' ambitious NeXT system still lacks color support. The prohibitive costs of providing color at NeXT's level of screen resolution leave it as a high-priced monochrome system.

Bringing multimedia capabilities to the majority of office desktops would be an extremely expensive proposition at today's prices. A 386-based system possessing a minimum multimedia configuration, for example, a video board, and MIDI sound support, and CD-ROM or optical storage can cost $10,000.

Certainly the various technologies named by the term *multimedia* will experience gradual but steady growth in the next few years. Their success, however, will be in specific applications where multimedia offers clear benefits to offset the costs of the technology.

Widespread adoption of multimedia applications, however, will not occur until hardware costs are much lower than they are today. At least two or three years are needed, and, more likely, not before 1994 or 1995 will processing, memory, and storage costs fall to levels low enough to make multimedia capabilities affordable for most personal computer users.

Until then, let's enjoy the demonstration videos and daydream about how nice it will all be. But when it comes to getting the job done in business, a healthy skepticism about multimedia and an insistence on seeing concrete benefits to justify the cost will be in order for some time. ■

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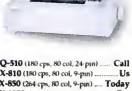

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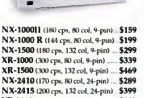

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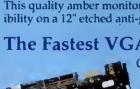

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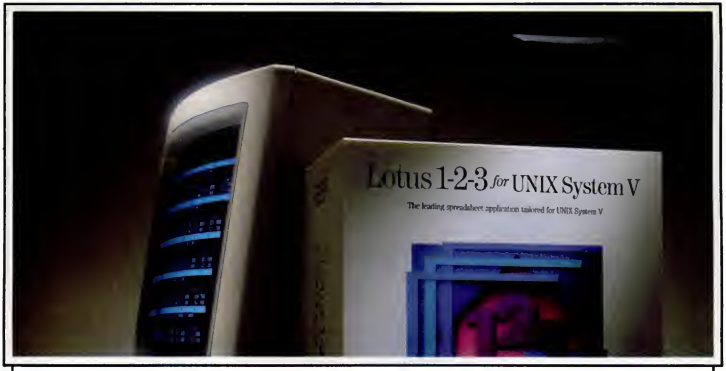

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The First 24 486s:

Giant Step *or* Stepping Stone?

by Jim Seymour

PHOTO JOON LEUNG

Promises of speed and power abound from the 24 vendors entered in the 25-MHz 486 PC race. But two questions remain: Will these machines deliver? And at what cost?

"*On every occasion, to shout 'More!!!'*"

That, legend has it, was the response when a pesky reporter once asked Samuel Gompers what the role of the modern labor leader should be.

Computer journalists seem to subscribe to the same ethos. A new chip runs at 16 MHz? Fine—but why not at 25 MHz? RAM prices have fallen by a third? Swell—but why not by two-thirds? A new spreadsheet can handle a million cells? Why not five million?

That perpetual dissatisfaction—we prefer to think of it as divine discontent, thank you—lies at the heart of evaluations of every new computer product. Sure, it's nice that the new stuff is smaller, faster, cheaper than last month's goodies—but what have you done for us *lately*, vendors?

Part of this process involves asking whether the newest, smallest, fastest wonder products provide a really useful margin of improvement over the old champs for most users. And whether the price paid for that improvement is in some reasonable proportion to the value received.

BETTER LATE THAN NEVER—OR IS IT?

The first PCs based on Intel's 25-MHz 80486 chip are in many ways enigmas. While they undeniably rest on advanced technology, they also arrived in the market later than expected—due mainly to Intel's painfully public problems throughout the summer and fall of 1989, as it tried to shake bugs out of the masks used to create the 486 chips. (All 24 machines tested use the B6-step 486 chip, Intel's latest version.)

They also run at a slower clock speed than many people expected. We've been at the 33-MHz level in 80386 machines for some time; vendors were openly demonstrating 33-MHz 486 designs at last fall's Comdex. Why, some buyers ask, consider a 25-MHz 486 at this late date?

Power-hungry PC buyers are also puzzled by other issues—such as lack of support for the 486's burst-transfer mode, and the use of the old PC AT (ISA) bus. When the 486 chip was formally introduced at the 1989 Spring Comdex, Intel said that 486 PCs should run two to four times as fast as their 386 counterparts. But no 486 yet seen comes close to that claim; on the average, these 25-MHz 486s offer perhaps 10 to 15 percent better performance than 33-MHz 386s.

What's up?

Those thoughts were much with us as we reviewed this first crop of 25-MHz 80486-based PCs: machines from ACMA, Amax, AST, Blackship, Club AT, CompuAdd, Computer Market Place, CSS, Dataworld, Everex, Gateway 2000, Micro Express, Micro Telesis, Mitsuba, Northgate, Osicom, PC Connections/Destiny, Polywell, SAI, Swan, Syntrex, Transource, Tri-Star, and Twinhead. Are these machines, like the fast 386s that we've reviewed in previous issues, well suited for individual users? Or are they really more appropriate as file servers on local area networks?

What about the even faster 33-MHz 486 machines already appearing on the market, and the 50-MHz machines soon to come? Is this 25-MHz generation of PCs destined to be soon forgotten?

For our tests of the first wave of 486s, we set up selection criteria more complex and power-hungry than we've ever before used—on the assumption that, at least for now, these are the muscle machines for those who crave all the PC power they can buy. Thus, in rounding up 24 25-MHz ISA-bus 486 computers that were shipping by mid-May, we asked vendors to supply a standard configuration including 4MB RAM, a 100MB hard disk or larger, a VGA or Super VGA display and adapter card, and a keyboard. We decided to include machines with an FCC Class A rating (office use only); though we have sometimes insisted on Class B certification (home and office use), we decided that both the power of the machines and the early state of the technology argued for a less exclusive criterion.

> **One analysis of the 486 is that it's a vendor's chip rather than a user's chip.**

A VENDOR'S DREAM CHIP

The 80486 chip is really just a 386 with some of its optional external support chips brought in from the cold—most significantly, a math coprocessor and a processor RAM cache built right in. That certainly has benefits for the buyer: more features and maybe a performance boost too, without adding extra cost. But the 486 chip also has substantial benefits for PC manufacturers.

Indeed, one analysis of the 486 is that it's a "vendor's chip" rather than a "user's chip." With several functions integrated on one piece of silicon, it lets PC makers design simple, easy-to-build motherboards—and also frees manufacturers of the need to develop proprietary routines for such performance tricks as caching.

A few rewritten instructions already in the 486's silicon may lead to faster execution of existing program code; a few new instructions may someday mean something if programmers create 486-specific programs (a dubious proposition, since those products would be incompatible with the great majority of existing PCs). But most of the leverage of these first 486 machines comes from the built-in math coprocessor and processor RAM cache. Both features can substantially speed up your computing work. And both are often misrepresented, leading to confusion and sometimes to unmet expectations.

HIGHER SPEED FOR HIGHER MATH

Intel's much-misunderstood series of math coprocessors—from the 8087 to the 80287 and finally the 80387—has come to an end. There will be no 80487, because Intel built that chip into the same silicon that holds the 486 microprocessor. Thus, if you are among those whose PC use includes a lot of work that involves floating-point math—CAD users, for example, or those who work extensively with statistics or graphic design—you can save the $400 to $600 you would spend for a fast 387 chip to use with a 25- or 33-MHz 386 PC.

That alone can change the economics of the 486 buying decision. But before you get out your credit card, make sure your work will really benefit from math coprocessing.

By handing off to a separate chip (or, in the case of the 486, a separate internal module) those complicated higher-math calculations that would otherwise slow down the CPU, math coprocessing can dramatically speed such tasks as, say, the vector processing that goes on in *AutoCAD*. But for math coprocessing to make a real difference, your software and your own work must meet two tests. First, your application must be aware that math coprocessors exist, must check for one, and if it is present, must use it. Second, the work to be performed must lend itself to a division of labor in which lower math is kept in the CPU, higher math shipped over to the math coprocessor.

Today, the first test is easy to meet: many math-intensive programs support math coprocessors. But the rules for passing the second test are less obvious.

For CAD programs, and for many drawing and design programs the work demands and is greatly accelerated by math coprocessing. With applications such as spreadsheets, however, consider carefully the way you use your programs. *Lotus 1-2-3*, for example, has supported math coprocessors ever since Release 2.0. But math coprocessing doesn't help a bit with most *1-2-3* spreadsheets.

That's because worksheets that rely on adding, subtracting, multiplying, and dividing your input—the overwhelming majority of business spreadsheets—are going to be recalculated entirely within the CPU itself. Only if you start using sines, cosines, logarithms, and lots of other higher-math operations will the math coprocessor be called into play. A math coprocessor module, whether built-in or external, can speed up those calculations a hundred

times or more—though the overall perceived speed gain will be far smaller.

But ask yourself: How many worksheets have you built using cosines? For that matter, do you know anyone who's ever built a worksheet using that kind of higher math?

If your answer is yes, you're probably a mathematician, statistician, or physical scientist—and you should run, not walk, to the nearest 486 outlet. If your answer is no, keep reading.

CACHE SIZE: IS MORE BETTER?

The second major change evident in the 80486 chip is Intel's abandonment of the external cache-controller chip architecture of the 80386. Second-generation and later 386 PCs often included the 82385 cache controller, which managed a small block of static RAM used to feed data from DRAM memory chips to the CPU.

By bridging the gap between the relatively slow dynamic RAM chips and the 386 chip—which typically executes instructions two to three times as fast as DRAMs can hand off the next chunk of data—processor caches became a mark of up-to-date design. Indeed, before long, *not* including the cache controller chip in a PC design seemed to mean that a vendor was punting, forgoing that last extra iota of added performance that true power users demand.

And that led to the my-cache-is-bigger-than-your-cache game, with vendors increasing the cache size with every new model. When IBM lapped the field with the PS/2 Model 70-A21, which doubled to 64K the size of the cache that the 82385 chip managed, technology buffs oohed and aahed: *that* was power. Soon, ALR and others stretched the cache size to 128K, then 256K—despite evidence that expanding cache memory beyond the 32K the 82385 controller was designed to manage produced only small improvements.

The effectiveness of a cache is measured by its "hit rate"—the percentage of time that data requested can be found among the data already held in the cache, rather than requiring a time-consuming trip to dynamic memory. Because a 32K cache managed by the 82385 consistently produces hit rates in excess of 90 percent, even much larger caches will only slightly improve system performance.

When Intel introduced the 486 chip with only 8K of on-board cache memory, muscle-PC buffs frowned. A mere 8K? How could that do any good?

COVER STORY
25-MHz 486 PCs

INTERIOR CONFIGURATION KEY

CASE

Cases typically come in five sizes: full desktop (shown here), three-quarter desktop, small-footprint, tower, and minitower.

MOTHERBOARD

Motherboards typically come in three sizes: full size (shown here), three-quarter size, and small-footprint size.

EXPANSION BOARD SLOTS

Different slots hold three different sizes of boards: one-half, three-quarter, and full size. A three-quarter-size slot is shown here.

POWER SUPPLY

Power supply options fall into four categories: large (shown here), medium, small, and long and narrow.

DRIVE BAY

Drive bays typically come in four different sizes: full-height (shown here), half-height, one-third-height, and 3.5-inch size.

Vendors picked up the theme. Though Intel said that 8K internal (or "associative") cache was the equivalent of a 32K external cache, the numbers game was once again irresistible. Thus, we're seeing 486s that build upon the 8K internal cache with sizable blocks of external cache memory, despite the clear evidence that a larger cache makes a very small contribution.

POWER AT A PRICE

Though we did specify more-powerful configurations for these 486s than we have ever required before, consider whether your application may require even more muscle—and how that will affect the price you pay to get into the 486 game.

For example, though we asked vendors to let us test machines equipped with 100MB hard disks, many users of 486 PCs in CAD, desktop publishing, and other design-related roles will want much larger disks. With the enormous graphics files created by scanners (especially when color information is being recorded), with the huge chunks of disk space required by screen-font bitmaps, and with drafters' and publishers' frequent need to keep many current jobs on-line on the active disk, 300MB to 600MB of space may make more sense.

Similarly, as good as VGA and particularly Super VGA may be, the higher resolution of 1,024- by 768-pixel displays makes a lot more sense for graphics applications, and also for those adopting *Microsoft Windows* 3.0 or OS/2 Presentation Manager as their standard interface. Adding a 1,024 by 768 graphics card (probably with a graphics accelerator chip) and a 20-inch 1,024 by 768 noninterlaced monitor can easily add $4,000, at typical street prices, to the tested-configuration prices we supply for 486 PCs.

Although the 4MB of RAM we specified in our standard configuration should get even *Windows* and PM users started, our experience with graphics operating environments suggests that before long you're going to want to look at another 2MB to 4MB of memory. Of course, if you're setting up one of these machines as a network server, running *Advanced NetWare*, *VINES*, or (especially) *LAN Manager* 2.0, the game starts at 8MB or more. At about $100 per megabyte, that's another $200 to $400.

Perversely, these demands for greater power tend to concatenate: the desktop publisher wants 486 power, *and* a large, fast hard disk, *and* a large, high-res display, *and* more RAM . . . and the price tag soars skyward.

If you're bent on turning your shiny new 486 into a *real* hot rod, setting it up to compete with engineering and scientific workstations such as Sun Microsystems' SparcStations, IBM's new RS-6000 RISC machines, and other maximum-performance systems, you may also want to add a Weitek math coprocessor.

Wait a minute: Doesn't the 80486 already have a math coprocessor built in? It does, and that coprocessor works well. For standard business applications such as spreadsheets and databases, and for virtually all current releases of popular graphics and CAD packages, the level of performance boost provided by the 80486's on-board math coprocessor is ample.

Later this year, however, software ven-

EDITOR'S CHOICE

• Northgate Elegance 486/25

While the 24 486/25 PCs that we tested showed about a 15 percent gain in processor speed over comparably configured 386/33s, the differences between the fastest 486/25 and the slowest were so minimal that they hardly helped us to narrow the choice.

Only one machine stands out as a winner because of its wealth of features: price, design, service, and finally, performance. Northgate's Elegance 486/25 offers the extras you would expect from this top-of-the-line category: 4MB RAM, more than 200MB of hard disk storage, *Windows* 3.0—high-end trimmings for a high-end system, and it comes at a competitive price of $5,830. You could pay less for a 486 system, but you might not get the bonuses that are offered with the Elegance.

Even without any BIOS shadowing, the Elegance 486/25's system and video performance equals that of most machines with shadowing. Similarly, without the caching disk controller, the hard disk performs admirably. An FCC Class B rating adds the final touch of class to this system.

Tri-Star's $5,555 486/25 would have received Editor's Choice if its video scores had been a little better. Instead, it rates an honorable mention for its thoughtful design touches, two-year warranty and excellent service program. Consider this tower if you're looking for a top-notch file server.

AST Research also deserves honorable mention for its AST Premium 486/25. Here is a machine whose top-quality construction and promise of easy upgrades via its proprietary Cupid technology will prevent the new class of 486/33 PCs from rendering the 486/25 model obsolete. At $10,944 for our standard configuration (including a 100MB hard disk), this machine is one for the user who wants power at any price. Fortunately, the system is available through dealers, often with a discount of up to 25 percent.

Special mention should also be made of Micro Telesis's MT 486DX. If you want power without sacrificing desk or floor space, this machine is worth serious consideration—especially at $4,999 for *PC Magazine*'s standard configuration. The MT 486DX comes in at 7 by 14.75 by 16.25 inches, and it's expandable, with room for up to 16MB of RAM.

dors will be rolling out new software packages, such as *AutoCAD*'s photo-realistic 3-D walk-through system, built around Pixar's Renderman technology, which take advantage of the Weitek units' additional calculation support. Increasingly, PC software dealing with millions of vector calculations, as in rotations, solid modeling, and other aspects of finite-element analysis, will look for and use Weitek chips, providing up to twice the perceived speed of PCs using the 486 chip alone.

The admission ticket is steep (Weitek's 4167-25 chip, made to work with the 25-MHz 486, lists for a cool $1,395), but the payback is steep, too. Remember that you don't have to buy the Weitek chip now, but you do have to make sure a socket for it is built into the motherboard of any 486 PC you may want to beef up later.

COMING SOON: 50 MHz

Keep in mind that faster 486s are already on the way. Many vendors offering $6,000 to $8,000 25-MHz 486s have also announced $6,500 to $9,500 33-MHz 486s. Just as the first 16-MHz 386 PCs were soon obsoleted by 20-MHz versions that made the early boxes look a little silly, these first-iteration 25-MHz 486s may well soon disappear. Faster-still 50-MHz 486s will take somewhat longer: Intel is not expected to ship the 50-MHz version of the chip until about October of this year.

There's another factor at work in exploiting the 486 chip: faster buses. This review covers only 486 PCs using the 16-bit ISA (PC AT–style) bus. Look for reviews of EISA- and MCA-bus 486 machines as they become available.

A good case can be made that whatever the speed of the CPU, making the most of a 486 demands a faster 32-bit bus. Today's speedy 386 and 486 PCs run into a severe I/O bottleneck in moving data over the narrower, slower ISA bus. (While the EISA bus runs at the same nominal 8-MHz rate as ISA, EISA's 33-MHz burst-transfer rate makes it effectively far faster.)

A WORTHY FILE SERVER

What do you really get for your money in these first 486s to reach the market?

Compared with the previous speed champs, the 33-MHz 386s (last reviewed in *PC Magazine*, February 13, 1990), these machines generally provide a 10 percent overall performance gain, at a 20 to 30 percent increase in price.

If you're looking for speed at any cost, that makes the buying decision easy. Most of these machines will outperform comparable 33-MHz 386s, if sometimes only slightly, and the best of the lot will provide an interesting but not dramatic gain.

If you're measuring performance gain against cost, however—if you're looking at the computer industry's classic price/performance ratio—you'll want to think twice. How badly do you really need that increase?

For standalone single-user applications, the advantages of the 25-MHz 486 PC probably don't justify their 20 to 30 percent price premium. For use as network servers—where speed is second only to reliability, and price far less important than either—they may be worthwhile.

But well-designed 486 servers should exploit the additional performance gains possible with the EISA and MCA buses' high burst-transfer rates. Likewise, with Intel's 82355 Bus Mastering Interface Controller chip, the 32-bit buses can use bus-mastering techniques to take much of the I/O load off the CPU; this too should result in greater speed. None of these machines are in that league. Thus, for multiuser applications, none of them seriously challenge more-complex, more-advanced architectures, as in the much more expensive Compaq Systempro.

As is so often the case when PC Labs tests a class of comparable leading-edge products these days, performance similarities far outweigh the performance differ-

ences. None of these machines cross any imaginary line between micros and minis, let alone between micros and mainframes.

The question most buyers will need to answer is this: Is the pain worth the gain?

ACMA COMPUTERS INC.

ACMA 486/25

by Alfred Poor

Neither rock-bottom cheap nor premium-priced, the ACMA 486/25 comes equipped for top performance. The standard configuration (as specified by *PC Magazine*) costs a modest $5,449. Yet that price includes 4MB of RAM, a 109MB hard disk, a combination floppy/hard disk controller that runs a single high-density floppy disk drive (3.5- or 5.25-inch), a super VGA monitor, one parallel and two serial ports, and a game port.

Our $7,595 test unit was souped up with a 360MB Maxstor hard disk and Ultrastor's fast ESDI controller, including an 8K on-board cache, which helps a little in speeding up hard disk access. On PC Labs' benchmark tests, the disk performance scores were good, surpassed mostly by those machines equipped with more-intelligent controllers like the DPT.

The tower configuration also included a second floppy disk drive, an NEC MultiSync 3D monitor, and an ATI 16-bit VGA card with 512K memory. The computer lets you attach the included ATI bus mouse to one of the video adapter's ports, which is a welcome slot-saving feature.

The American Megatrends Voyager 486-AT motherboard on the evaluated system was filled with 4MB above the base memory, for a total of 8MB. To get up to 24MB of 32-bit RAM, you need an optional card ($200 without memory) that fits in the proprietary 32-bit slot. The motherboard also holds a 128K static RAM cache, which the vendor claims speeds up access to the system RAM.

The ACMA is a versatile machine. For instance, the system's whopping 450-watt power supply has the ability to adjust to European power voltages automatically without making you change a switch.

A 12-MHz crystal on the motherboard provides a responsible way of running the system's bus at higher speeds. An 8-MHz crystal is also included to slow the machine to standard speed if required (as when you're using finicky, older expansion cards that give unpredictable results at higher speeds); just place it in the socket occupied by the 12-MHz crystal. While other companies use the same motherboard, few take the extra step of providing a choice of crystals. While you can buy a crystal on your own, its inclusion is a small but welcome benefit.

In terms of general performance, the ACMA is a prince among peers. Among all the machines in this review, the differences in CPU and memory benchmark test scores are so small that you probably could not tell the difference using most standard applications, but the ACMA did manage to pull just slightly ahead of the tightly grouped pack.

There are some weak points in the system. Although the unit has been shipping since March, the 486 documentation was not ready in time for this review, so ACMA substituted a 386 system manual. With luck, the 486 manual will not resemble it. More than half the documentation consisted of generic manuals from the vendors of the hard disk, video adapter, disk controller, and I/O card, and these were of uneven quality.

For a low-priced contender, the ACMA 486/25 ($7,595) offers name-brand components and above-average performance. If you need friendly documentation, though, you'll have to look elsewhere. ACMA substitutes the manual from its 386 for the real thing.

PC MAGAZINE FACT FILE

ACMA 486/25
ACMA Computers Inc., 117 Fourier Ave., Fremont, CA 94539; (800) 456-1818, (415) 623-1212.
List Price: With 4MB RAM, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, one parallel and two serial ports, game port, 230-watt power supply, $4,195; with 109MB hard disk, super VGA monitor, DOS 3.3 or 4.01, $5,449; with 8MB RAM, 360MB hard disk, 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, 450-watt power supply, $7,595.
In Short: The ACMA 486/25 is slightly faster than the rest of the machines in the pack, yet the price is not far from the bottom of the range. Assembled from name-brand components, it is strictly generic in the quality of its documentation. For those who do not need to rely on the manuals, the ACMA 486/25 represents a good value in a top-end machine.

CIRCLE 417 ON READER SERVICE CARD

The ACMA 486/25 is not the least expensive machine in this group, but it is closer to the bottom of the price range than the top. Add to that its good performance and thoughtful extras and you have a system that is well worth investigation.

AMAX ENGINEERING CORP.

Amax 486/25 Power Station

by Bill O'Brien

The sculpted lines of the Amax 486/25 Power Station's tower enclosure are quite pleasant to look at. That's not enough to make a good computer, but in this case, function follows form with the prize you find inside this box.

For $5,499, you can get a basic system that coincides with *PC Magazine*'s standard configuration: 4MB RAM, a Toshiba 109MB hard disk, 128K processor RAM cache, 5.25-inch and 3.5-inch floppy disk drives, a 14-inch monitor with 1,024 by 768 resolution, and DOS 4.01. Our tested configuration, at $8,799, includes an upgrade to 8MB RAM, a 153MB ESDI hard disk, a 120MB Colorado tape drive, and a 20-inch monitor.

This 486/25 starts life as an AMI motherboard with selectable bus speeds of 8 and

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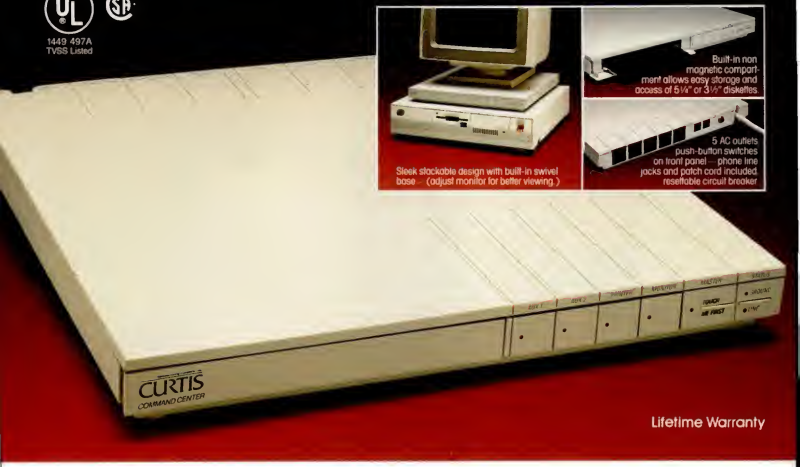

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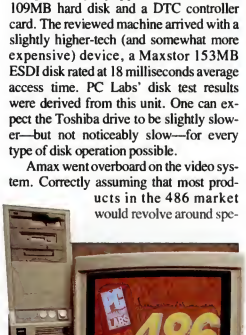
12 MHz. But the higher bus speed requires replacement of the bus oscillator—a task few normal people would want to perform. The majority of the board is covered in discrete components, but Amax has gone with a Chips and Technologies 486 chip set. Guiding 486 operations is an AMI BIOS.

Counted under the discrete chip control is the 128K of 35-nanosecond processor RAM cache. The board is loaded to maximum at that level. In our tested unit, the cache RAM connected the processor to 8MB of 80-ns. system RAM, which is the maximum that the motherboard can hold in its eight rows of SIMM sockets. Amax does claim that the 486/25 will support another 16MB through a 32-bit proprietary slot, bringing the system maximum to 24MB.

The standard configuration comes competitively equipped with a Toshiba 109MB hard disk and a DTC controller card. The reviewed machine arrived with a slightly higher-tech (and somewhat more expensive) device, a Maxstor 153MB ESDI disk rated at 18 milliseconds average access time. PC Labs' disk test results were derived from this unit. One can expect the Toshiba drive to be slightly slower—but not noticeably slow—for every type of disk operation possible.

Amax went overboard on the video system. Correctly assuming that most products in the 486 market would revolve around specialized tasks, Amax included a wondrously large 20-inch Seiko monitor—an excellent match to the ATI 1,024 by 768 video card, which was also part of the tested configuration. In CAD/CAM applications, this setup would be difficult to beat. The less expensive video display system included with the standard configuration is no visual slouch either. This bottom-line video consists of a Paradise VGA board and an Impression 14-inch monitor, neither of which is in any way a bottom-of-the-line performer.



For $5,499, Amax Engineering Corp. offers nothing less than a system that actually allows you to do work. The basic configuration includes 4MB RAM, a 109MB Toshiba hard disk, two floppy disk drives, and a 14-inch color monitor with 1,024 by 768 resolution.

There are, however, two restrictions to buying a 486/25. The first is that, despite an attractive base price that may have you anxiously clearing a space in your home, the tower configuration is rated Class A by the FCC. This is not an insurmountable obstacle, because Amax has a range of cases that will wrap around the electronics, and at least one of the desktop versions will move this into Class B territory.

Overcoming the second restriction will require a phone call. Amax does not sell directly to the public. It does distribute its equipment through a variety of dealers, much as IBM does, and your phone call will get you the number of a dealer near you. It's also through the dealer network that Amax backs up its one-year parts-and-service warranty, and an optional on-site service plan is handled through Memorex Telex.

It's odd to find a basic configuration that will actually let you do work, but Amax will sell you nothing less than a well-stocked system. The Amax 486/25 Power Station definitely deserves a nod for its price/performance ratio—and a grin for its price alone.

FACT FILE

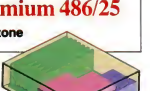
Amax 486/25 Power Station
Amax Engineering Corp., 47315 Mission Falls Ct., Fremont, CA 94539; (800) 888-2629, (415) 651-8886.
List Price: With 4MB RAM, 109MB hard disk, 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, 14-inch monitor (1,024 by 768 resolution), DOS 4.01, $5,499; with 8MB RAM, 153MB hard disk, 120MB tape drive, 20-inch monitor (1,024 by 768 resolution), $8,385.
In Short: The Amax 486/25 is a moderately priced, reasonably performing computer with an abundance of add-on peripherals from Amax to increase its computing potential.

CIRCLE 418 ON READER SERVICE CARD

AST RESEARCH INC.

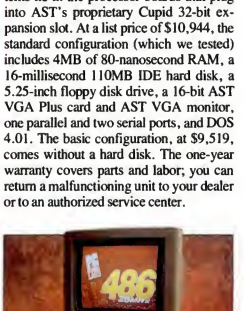
AST Premium 486/25

by M. David Stone



Although this is *PC Magazine*'s first overview of 486 ISA-bus systems, the AST Premium 486/25 is an old acquaintance. In fact, you can convert any one of the Premium series computers into any other simply by replacing one board. The Premium 486/25's chassis, the AST BIOS, and even the system board are essentially identical to those of the AST Premium 386/33 (reviewed in *PC Magazine*, October 31, 1989) and the AST Premium 386SX/16 (January 30, 1990).

The only differences among the systems lie in the processor boards that plug into AST's proprietary Cupid 32-bit expansion slot. At a list price of $10,944, the standard configuration (which we tested) includes 4MB of 80-nanosecond RAM, a 16-millisecond 110MB IDE hard disk, a 5.25-inch floppy disk drive, a 16-bit AST VGA Plus card and AST VGA monitor, one parallel and two serial ports, and DOS 4.01. The basic configuration, at $9,519, comes without a hard disk. The one-year warranty covers parts and labor; you can return a malfunctioning unit to your dealer or to an authorized service center.



Presto! Any Premium 386/33 or 386SX/16 from AST Research can become a Premium 486/25 by simply changing the processor board. Such easy upgrades come at a price, however—$10,944 for a 486 PC with 4MB RAM, a 110MB IDE hard disk, a 1.2MB 5.25-inch floppy disk drive, and a VGA monitor.

Physically, the Premium 486/25 is slightly narrower than a standard desktop box, measuring 6.25 by 25 by 16.5 inches (HWD). Quality construction yields a chassis with rigid support for the system board. The five half-height drive bays follow the common arrangement: a stack of three plus a stack of two, with three bays accessible. Only two of the bays on the review unit were filled, by the 1.2MB floppy disk drive and the 3.5-inch hard disk (manufactured by Imprimis Technology).

The Premium series design is not a passive backplane. Instead, the AST processor board is limited to those components that depend on processor type or speed. (If you have a Premium 386/33 or 386SX/16, you can upgrade to the Premium 486/25 simply by changing the board.) Everything else is on the AST system board—including the AST BIOS and the chip set, which consists of one Chips and Technologies chip plus discrete logic.

AST's 486/25 processor board includes the 80486-25 chip, a socket for a Weitek 4167, and four SIMM sockets that can use 1MB or 4MB SIMMs. The review unit came with four 1MB SIMMs and no 4167. The maximum system memory is a substantial 48MB, with 16MB on the processor board and 16MB on each of two optional memory boards. The memory boards, which are $650 each with 1MB RAM, have 16 SIMM sockets each and support only 1MB SIMMs. The processor board has no cache beyond the 8K in the 486 itself; on PC Labs' tests, however, this doesn't seem to hurt the system's performance.

Most other items of interest are on the system board, including the parallel port and two serial ports, support for two IDE hard disks and three floppy disk drives, and seven slots—one 8-bit, three 16-bit, and three 32-bit—using AST's Cupid extension. The 32-bit slots can be used for standard 8-bit or 16-bit boards, but they are meant primarily for the processor board and optional memory boards. On the test system, five slots were still available, with one Cupid slot filled with the processor board and one 16-bit slot filled with the AST VGA Plus card.

The Premium 486/25 is upgradable as well. A 33-MHz 486 processor board is already for sale (at an upgrade price of $4,195), and AST expects additional upgrades to become available in time. According to AST, the system automatically detects the speeds of the installed processor and the installed memory. It then adjusts the system speed and the speed for the Cupid extension accordingly. All this lets the Cupid extension run at the maximum speed that the memory and processor can handle, while the ISA part of the bus runs at 8 MHz at all times.

The AST processor board has only those components that depend on processor type or speed.

Performance on PC Labs' tests was somewhat uneven. For processor and memory tests, where the differences among tested systems were too small to matter much, the Premium 486/25 scored generally midrange or a little worse. On video tests, scores were midrange or a little better. Disk tests gave the weakest results, placing the system convincingly in the bottom half of the pack. For better disk performance, however, you can buy the system without the IDE hard disk and install a faster disk plus a caching controller card.

With an FCC class B rating, the system is appropriate for a power user's home office. All told, the AST Premium 486/25 is a credible, high-quality system. It's somewhat pricey, but it offers intelligent design, acceptable performance, solid construction, and even the promise of upgradability.

FACT FILE

AST Premium 486/25
AST Research Inc., 16215 Alton Pkwy., Irvine, CA 92718; (714) 727-4141.
List Price: With 4MB RAM, 1.2MB 5.25-inch floppy disk drive, VGA monitor, one parallel and two serial ports, DOS 4.01, $9,519; with 110MB hard disk, $10,944.
In Short: Although somewhat pricey, the AST Premium 486/25 boasts quality construction and a proprietary design that promises to let you upgrade to faster processors with minimum bother. The Class B rating means that the system is licensed for use in a residential area.

CIRCLE 419 ON READER SERVICE CARD

BLACKSHIP COMPUTER SYSTEMS INC.

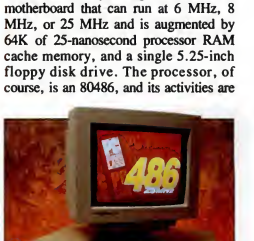
Blackship 486/25

by Bill O'Brien

A long time ago, when the treasure fleets sailed the waters of the dark Atlantic, it was the Black Ship that carried the gold back from the New World to Spain. You may not find any treasure hidden in the Blackship 486/25, but you may find a bargain.

The standard configuration, at $5,636, comes with 4MB RAM, a 64K processor RAM cache, 150MB hard disk, 1.2MB 5.25-inch floppy disk drive, VGA monitor, one parallel and two serial ports, a game port, and DOS 4.01. A better bet, however, might be to use the $3,995 basic configuration as your starting point.

Naturally, at that price level, little functionality is available from the desktop unit. The base-priced system lacks video or hard disk, and comes with a scant 1MB of system RAM. What you do get is a Micronics motherboard that can run at 6 MHz, 8 MHz, or 25 MHz and is augmented by 64K of 25-nanosecond processor RAM cache memory, and a single 5.25-inch floppy disk drive. The processor, of course, is an 80486, and its activities are



To get the most from Blackship Computer Systems' Blackship 486/25, start with the bare minimum: little more than a Micronics motherboard and the 80486 processor for a scant $3,995. Then add the components from your 386, for a realistic upgrade at a reasonable price.

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directed by discrete components rather than a large-scale chip set.

Blackship has turned to Phoenix for its BIOS, and the installed Version 1.10 10F ROMs had a worrisome 1/15/88 date, making it appear much too early a release to be totally effective in an i486 environment. Blackship has indicated that it is currently shipping an updated Phoenix BIOS, Version 1.10.10F5, with its systems.

PC MAGAZINE FACT FILE

Blackship 486/25
Blackship Computer Systems Inc., 4031 Clipper Ct., Fremont, CA 94538; (415) 770-9300.
List Price: With 1MB RAM, 1.2MB 5.25-inch floppy disk drive, one parallel and two serial ports, game port, $3,995; with 4MB RAM, 150MB hard disk, VGA monitor, DOS 4.01, $5,636.
In Short: The price/performance ratio of the fully configured Blackship 486/25 is unspectacular, but the base-priced system would make a realistic platform for upgrading from an existing 80386 or even a high-end 80286 computer.

CIRCLE 420 ON READER SERVICE CARD

The only other thing that arrives with the basic configuration is a lot of vacant space. Even if this is your first venture into computing, you should realize this is not the configuration to buy. The price may be attractive, but it lacks the amenities you need for actually doing some work. But if you're upgrading from an i386 environment or a high-end i286 machine, you may already have the added components you'll need to turn the basic configuration into a working machine.

First and foremost, you'll need to increase the RAM capacity, and at this level of computing, 4MB is the standard *PC Magazine* has selected. If you have 1MB 80-ns. SIMM modules lying around, Blackship will upgrade your system to a maximum of 16MB, at the cost of $120 [illegible]egabyte.

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[illegible] that you can trans[illegible]n, but VGA is the current vogue; if you can't reach that goal, you could opt for an Orchid ProDesigner card and an NEC MultiSync 3D monitor. The combination is very enticing and produces excellent video. With the video shadowing active, this pairing produces exceptional Video BIOS Routine test scores both with and without scrolling. The bump-up from the basic configuration price is $1,014 for the luxury.

If you have nothing to add to the basic configuration, Blackship will be happy to supply you with a totally functioning computer for $5,636. That includes a one-year warranty on both parts and labor, with return-to-dealer servicing or phone service available. If you're in the San Francisco area, Blackship can even arrange for optional on-site service.

The recommendation here is to go with the base-priced system as an upgrade to your current equipment. The performance of the add-in components in the Blackship 486/25 is not so great that using older components would dramatically reduce its operating efficiency. That route will give you a seamless entry into 486 computing at a relatively low price.

CLUB AMERICAN TECHNOLOGIES INC.

Club Hawk II

by Bill O'Brien

Club AT's Club Hawk II stands out for both its completeness and its low price. Equipped with 4MB of 80-nanosecond system RAM, a 64K RAM cache, 150MB hard disk, 5.25-inch and 3.5-inch floppy disk drives, and VGA monitor, the standard configuration's list price is a scant $5,795.

Mounted vertically inside the standard-size tower is a Club AT motherboard using a VLSI 80486 chip set. BIOS functions are handled by AMI ROMs with the surprisingly early date of 2/19/88. When it comes to the processor RAM cache, Club AT hasn't sacrificed horsepower: the 64K cache uses very expensive and very fast 20-ns. devices.

The system RAM addressing is accomplished through a page-mode arrangement, and it's here that the fast cache comes into play. While all of the reviewed machines passed through PC Labs' 80486 Instruction Mix, Floating-Point Calculation, and Conventional Memory tests at equivalent levels, the Club AT Conventional Memory access times suffered slightly in comparison to the rest. Most likely, it was the fast cache that pulled the system back into line with the other tested machines on the Floating-Point test.

At $5,795, Club American Technologies' Club Hawk II offers affordable midrange performance in a standard-size tower. If the machine gets FCC Class B approval, it will be ideal for use as a home-office workstation.

The motherboard is capable of handling 8MB of SIMM-packaged memory, and with the addition of an add-in board, the total system RAM can be boosted to 16MB. Club AT's $90 price for a 1MB memory upgrade is one of the lowest around. Even with the $135 price of the expansion board, topping off your system to its full memory capacity costs only $1,215. That provides a real power user's system, and the list price is still just $7,010.

The 250-watt power supply that also comes standard is not one of the exotic varistor-operated dual-fan models, but it's ample for almost any group of boards that might find their way into the eight I/O slots. With the power supply's six device connectors, you can load the tower case to its half-height drive capacity and still have a connector left over.

Club AT doesn't scrimp on the video, offering an Everex ViewPort Super VGA

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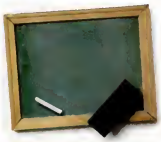

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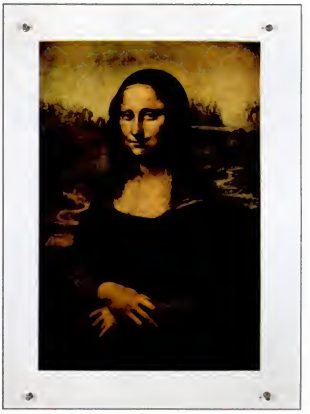

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card with a Zymos chip set and its own 14-inch multiscanning monitor, which is capable of 1,024 by 768 resolution. This monitor, the Club Multi, has one of the fullest complements of hand-accessible adjustment controls.

The machine we examined contained a 150MB Maxstor ESDI hard disk rather than the 71MB MFM Maxstor that's common fare for the base-priced computer. As PC Labs' benchmark tests affirm, the ESDI disk drive is a fast device, quicker than its smaller MFM counterpart. The ESDI drive and 1.44MB floppy disk drive

The Club Hawk II's basic configuration is as capable as it is affordable.

on the reviewed machine add only $800 to the $4,995 basic configuration, and it's plainly money well spent.

Keyboard dynamics are quite subjective (Club AT supplied one of many possible Key Tronic 101-key types), but note that the company ships a 10-foot keyboard extension cable with its tower systems, easing the strain of stretched cables routed under desks and around lamps.

While there may not be anything spectacular about the Club Hawk II, neither is its price awe-inspiring. The budget-conscious searching for a single-user system will find the basic configuration as capable as it is affordable. And the standard configuration is priced attractively enough to appeal to all but the most frugal.

FACT FILE

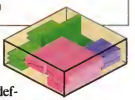
Club Hawk II
Club American Technologies Inc., 3401 W. Warren Ave., Fremont, CA 94539; (415) 683-6600
List Price: With 4MB RAM, 71MB hard disk, 1.2MB 5.25-inch floppy disk drive, VGA monitor, one parallel and one serial port, $4,995; with 150MB hard disk, 1.44MB 3.5-inch floppy disk drive, DOS 4.01, $5,795.
In Short: Club AT's 486/25 is an affordable office workstation with midrange performance. If the base system had an FCC Class B rating, it would make an ideal home workstation as well.

CIRCLE 421 ON READER SERVICE CARD

COMPUADD CORP.

CompuAdd 425

by Bruce Brown



The CompuAdd 425 ranks as a model of space efficiency, definitely appealing to the power user who doesn't have a lot of desk room to spare. The small-footprint box houses a 25-MHz 80486 chip, but the system's size imposes storage-device and add-on-board limitations that make it unsuitable for use as a file server on any but the smallest of networks. The 425's ability to function in that capacity is also hampered by its memory restrictions.

CompuAdd's diminutive machine—4.25 by 16.5 by 15.75 inches—is priced at $5,670 as tested in its standard configuration. That price includes a fairly robust 4MB of RAM, a 110MB 15-millisecond CDC hard disk, a Key Tronic 101-key keyboard, CompuAdd's 16-bit Super VGA Hi-Rez video adapter, and a 14-inch Seiko CM-1440 Super VGA monitor (also capable of operating in 1,024 by 768 interlaced mode). The system scored particularly well on our three video tests, and within the normal range for all 25-MHz 486 computers on the other benchmark tests.

As mentioned, the CompuAdd's storage limitations are somewhat restrictive. The 425 has room for only three storage devices inside the case: one half-height and two 3.5-inch units. The tested computer's drive bays were full, with 5.25-inch and 3.5-inch floppy disk drives as well as the hard disk. You'd have to give up a floppy drive in order to use an internal tape backup unit or a second hard disk. If you choose the latter, you can always opt for an external tape drive, although putting a storage device outside the case somewhat defeats the purpose of buying a compact system in the first place.

CompuAdd makes its own motherboard, using a 486 chip set by OPTI (a company less well known than Chips and Technologies, but apparently quite capable of the job), and the Phoenix ROM BIOS. The system has no provision for the addition of an external RAM cache or auxiliary math coprocessor chip, relying instead on the 486 chip's internal 8K cache and math coprocessing circuitry.

Motherboard memory is limited to 8MB of 32-bit 20-nanosecond page-mode SIMMs. In a time when many companies are making machines with the capacity to hold 64MB of 32-bit RAM, the 425 oddly lacks even a 32-bit expansion slot. To exceed the 8MB of motherboard RAM, you need to install a 16-bit memory board. Besides breaking up the page-mode scheme (which works just with the motherboard memory), using 16-bit memory in a 486 computer is a wasteful idea not recommended by CompuAdd.

The circuitry for the parallel and serial ports and the floppy and hard disk interfaces is contained in the motherboard. This design innovation leaves the tree-style expansion bus to hold only the video card. The 425's complement of expansion slots

The CompuAdd 425 offers big power in a small package: the box measures just 4.25 by 16.5 by 15.75 inches. There may not be a lot of room to expand, but the $5,670 price tag makes this machine a good choice for the single user.

includes two 8-bit slots on one side of the tree and three 16-bit slots on the other; most standard-size desktop machines have one or two more.

CompuAdd sells computers through its direct-mail operation and via 89 retail locations. Standard with a 425 purchase are DOS 4.01, *Microsoft Windows* 3.0, *DOS Help!*, and *PC-FullBak*. A Microsoft Mouse that included *PC Paintbrush* also came with the test system, but CompuAdd may substitute other mice in the future.

The one-year parts-and-labor warranty includes unlimited toll-free technical support with replacement parts shipping if necessary, backed by an on-site service contract fulfilled by Memorex Telex. There's also a welcome 30-day money-

FACT FILE

CompuAdd 425
CompuAdd Corp., 12303 Technology Blvd., Austin, TX 78727; (800) 627-1967.
List Price: With 4MB RAM, 80MB hard disk, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, VGA monitor, mouse, one parallel and two serial ports, DOS 4.01, *Microsoft Windows* 3.0, *DOS Help!*, *PC-FullBak*, $4,995; with 110MB hard disk, 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, super VGA monitor, $5,670.
In Short: They call it a "pocket rocket" for good reason. The CompuAdd 425 is a small-footprint, low-profile machine best suited to single-user applications. With its limit of 8MB of 32-bit RAM, it isn't heavy on expansion room, but it is a quick machine with good support from a major vendor, at a competitive price.

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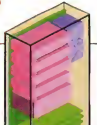
back guarantee in case the system doesn't live up to your expectations.

Backed by CompuAdd's support policies and available at a decent price, the speedy 425 is a smart choice for the single user. But as a file server or multiuser system, it can't compare to the cavernous tower cases of some of the machines in this review.

COMPUTER MARKET PLACE INC.

Ultra 486-25

by Bill O'Brien



Were it not for the beige bezels of the two floppy disk drives and the control panel, the Ultra 486-25 would make an ideal candidate for a Darth Vader look-alike contest. The sleek black tower stood out from the rest of the pack in appearance but didn't manage to distinguish itself otherwise.

The standard configuration, at $4,497, includes 4MB RAM, a 105MB hard disk, 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, a VGA monitor, one parallel and two serial ports, and DOS 4.01. There is also a stripped-down basic configuration with a meek sticker price of $3,189; like many of the base-priced machines mentioned in these reviews, the bottom-of-the-line Ultra 486 can hardly be used as more than a carrier for older components from other systems. It brings you a processor, a 5.25-inch floppy disk drive, one parallel and two serial ports, and the keyboard. Missing is RAM, a hard disk, and any shred of video. If you're upgrading your current 386 or high-end 286 system, this provides an excellent opportunity to merge the best components of two systems.

The platform for the Ultra 486-25 is an Advanced Integration Research motherboard topped to the maximum with 128K of 35-nanosecond processor RAM cache. As in all of the other computers reviewed, the AIR board also uses a discrete logic array to manage this secondary caching system. BIOS chores are handled by AMI ROMs.

In the tested machine (which has a list price of $5,889), system memory was boosted to 4MB of 80-ns. RAM. The Ultra 486-25 will hold a total of 16MB on the motherboard, configured in separate banks of 1MB SIMMs, and it is an imposing sight, this solid block of SIMM banks occupying nearly one-fifth of the motherboard's surface.

The tested machine came with an economical Micropolis 144MB hard disk with ESDI storage technology. With an average access time of 23 milliseconds, this is definitely not a performance-minded drive, and the Ultra 486-25 tries to help it along by including a Konan Ten-Time caching disk controller stocked with 2MB of 120-ns. cache RAM. Unfortunately, PC Labs' tests show that without 4MB or more RAM to conquer the large-record handling, the controller adds very little to the drive performance.

The high ticket item here is the caching controller, and Computer Market Place can supply you with an alternative non-caching controller for a 150MB ESDI hard disk at a $716 savings over the caching system's price. Or you could double your storage potential with a 300MB ESDI disk and standard controller and still manage to save $242. In either case, performance would drop slightly—but would be more commensurate with the price you pay.

While the Ultra 486-25's video system was not a visual disappointment, the 16-bit Ztech VGA board had a surprising amount of difficulty with our benchmark tests. Its Direct to Screen score was just barely better than average, while the Video BIOS Routine Without Scrolling test took nearly twice as long as the average, and even the scrolling numbers fared poorly. All of these tests were performed with video BIOS shadowing turned on, so there is no other help to be found in the system. At best, the Ztech card is a mediocre choice for this level of computing if your applications are video dependent.

Big and black, the Ultra 486-25 from Computer Market Place provides good performance at a fair price, as long as you replace the company's 144MB Micropolis hard disk and Konan TenTime TNT-2210 caching disk controller with a 150MB or 300MB noncaching version.

The Ultra 486-25 slides right into the middle of the pack of the reviewed machines. We doubt that it would make a dyed-in-the-wool power user smile, but outfitted without the caching disk system, it can do quite admirable work as an entry-level 486 computer without severely denting your budget.

FACT FILE

Ultra 486-25
Computer Market Place Inc., 450 Parkway, #202, Broomall, PA 19008; (800) 545-7397; (215) 359-0750.
List Price: With 1.2MB 5.25-inch floppy disk drive, one parallel and two serial ports, $3,189; with 4MB RAM, 105MB hard disk, 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, VGA monitor, DOS 4.01, $4,497; with 144MB hard disk, 2MB caching controller, $5,889.
In Short: The Ultra 486-25 is a midrange performer, but stripped of the caching disk system, its significantly reduced price makes it a reasonably attractive purchase for those on a tight budget.

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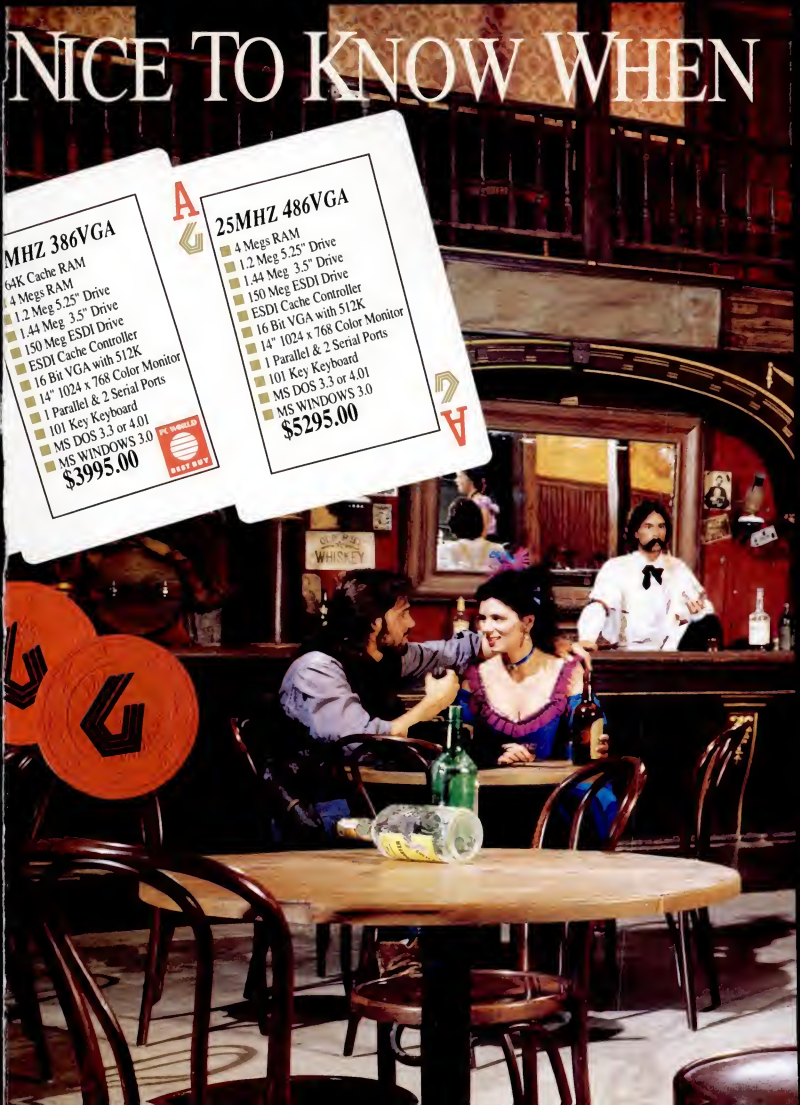

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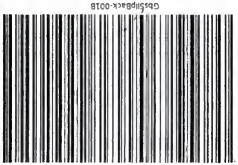
Inverted Back



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4. Close the page and slip-sheet

Inverted Foldout slip-sheet

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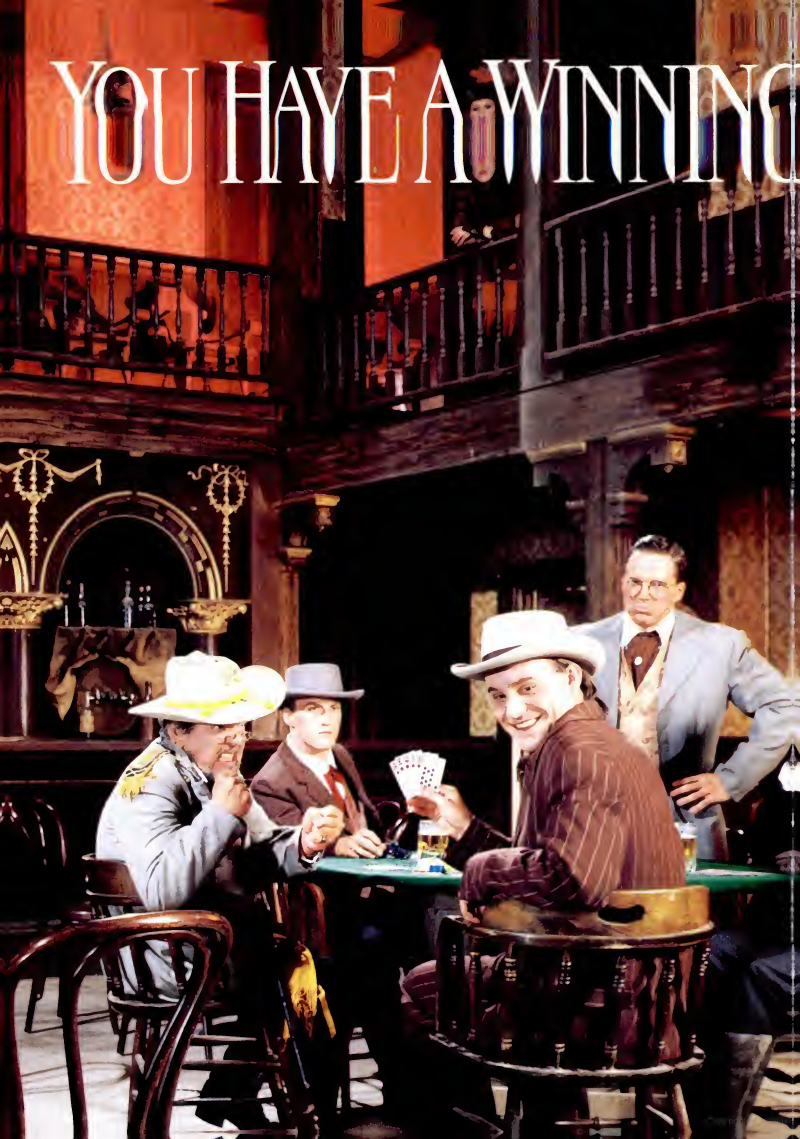
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25-MHz 486-BASED PCs: SUMMARY OF FEATURES

Standard configuration price For the sake of price comparisons, our configuration includes 4MB RAM, a 100MB hard disk or better, one high-density floppy disk drive, a color VGA video display, at least one parallel and two serial ports, a keyboard, and DOS. In some instances, manufacturers do not offer the exact configuration *PC Magazine* requested, but all 24 of the PCs reviewed here provide a reasonably close match for this list of requirements. Check each machine's fact file for a more exact indication of what is included at the quoted price.

Case type indicates whether each computer has a small-footprint, desktop, or tower design.

486 chip set manufacturer indicates which company makes the support logic that connects the CPU with the other functions managed by the system board. Chip sets that employ VLSI (very large-scale integration) technology reduce the discrete component count, which in turn helps to reduce power consumption and increase component life. In some cases the computer uses discrete logic rather than a chip set.

The **system RAM arrangement** is the method in which memory is addressed. Remember that CPU speed is usually faster than conventional memory speed.

Interleaved memory increases processing speed by dividing the memory into two or four portions that process information alternately. The CPU sends information to one section for processing while another section goes through a refresh cycle.

Page-mode memory allows back-to-back memory accesses within blocks of memory called pages, avoiding wait states.

Row/column is the traditional method of accessing data at a memory address. RAM is mapped as a matrix, and a particular address is given using a row and a column number.

In *static-column* memory, once data is located at a specific column address, subsequent pieces of data are accessed or allocated to the same column. Because the column is "static," data retrieval is faster.

Wait states On the average, most machines run at between zero and one wait state. For all intents and purposes, however, the 486 chip's built-in 8K cache eliminates the wait state. The figures printed here were supplied by the respective manufacturers.

Maximum installable RAM Separate rows indicate the maximum 32-bit memory possible on the motherboard and on a dedicated memory board, as well as the maximum size of the processor RAM cache.

RAM packaging (and rated speed) Memory chips come in a variety of styles: DIPs, SIPs, and SIMMs.

The *dual in-line package (DIP)* is the traditional buglike computer chip sprouting 8, 14, 24, 40, or more metal legs (evenly divided between right and left sides).

Single in-line packages (SIPs) are single-package arrays of computer chip logic assembled so that all connecting legs are in a straight line, like the teeth on a comb. They can be individual chips or multiple chips on a small card, with a proprietary SIP connection.

Single in-line memory modules (SIMMs) consist of individual logic devices installed on their own small circuit board, creating a component module that can be plugged into a larger device. Their physical arrangement facilitates installation and replacement.

Chip size Kb and Mb refer to kilobits and megabits, respectively. Combination chips (4x256Kb) are generally faster and more expensive.

The **BIOS version and date** can affect PC Labs' benchmark test results. Those purchasing the same machine with a different BIOS version may encounter some variations in performance.

Setup can reside either on a floppy disk or in ROM.

Shadowing Shadow RAM is a technology that loads system BIOS and/or video BIOS directly into fast RAM on boot-up of the computer, offering enhanced performance speed at the cost of 384K of memory from the first 1MB of system RAM. The ability to disable shadowing is important with some applications to resolve memory conflicts.

Hard disk interface Within the 386 PC environment, the three most common hard disk interfaces are *ST-506, SCSI (small computer system interface),* and *ESDI (enhanced small device interface).* ST-506 uses one of two data encoding methods, *RLL (run length limited)* and the older *MFM (modified frequency modulation)* scheme. All data is encoded onto and read from your hard disk as a series of polarity-reversing bits representing ones and zeros. The MFM format uses nine such bits to store the same amount of data that RLL can store with only six polarity changes.

Both SCSI and ESDI require special hard disk controllers and cannot run off existing PC-XT or PC AT controllers. A new interface that offers good performance at a lower price than ESDI or SCSI is *IDE (interface design enhancements).*

Bus speeds Bus speed becomes more important as computers run at faster clock speeds. A computer's bus speed may actually be too fast for expansion cards, most of which operate at 8 MHz. Note that the Micro Channel bus operates at 14.5 MHz.

The **display circuitry** can be either on an expansion card or on the motherboard. Motherboard circuitry is often faster, but if it cannot be disabled it prevents upgrades.

Interface 16-bit video interfaces are typically faster than 8-bit because of their wider bandwidth.

Software available For OS/2 and *Microsoft Windows,* the version number and list price are provided. DOS 3.3 or 4.01 is included as part of *PC Magazine*'s standard configuration for computers; it therefore is not listed here.

Disk caching software Some companies provide software to facilitate data retrieval from the hard disk. This software speeds overall system performance by anticipating what data the processor will need next.

An **expanded memory manager** is software that emulates the Lotus Intel Microsoft (LIM) expanded memory manager within the extended memory of a 386, 386SX, or 486 PC.

Switchable settings on the power supply are designed to permit a computer's use in both the United States and Europe. All of the computers in the current roundup have this feature; therefore it does not appear in the table.

Number of device connectors indicates how many internal storage devices the system can support without the use of Y cables (power splitters).

Hard disk options The number of different hard disks the vendor offers for a machine is often indicative of how much customizing is available. We are listing what we believe are the most popular disk choices (100MB, 120MB, 150MB, 200MB, 300MB, 600MB, and 1 gigabyte, or the vendors' closest available models).

FCC certification class Two classes of FCC (Federal Communications Commission) approval, Class A and Class B, may be given to computers. Class A approval signifies that a computer has sufficiently low radio-frequency emissions for operation in a business locale. The more stringent Class B rating allows home use as well, where computers are likely to be placed near radios and television sets.

CONTINUES

25-MHz 486-BASED PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	ACMA Computers Inc. ACMA 486/25	Amax Engineering Corp. Amax 486/25 Power Station	AST Research Inc. AST Premium 486/25	Blackship Computer Systems Inc. Blackship 486/25	Club American Technologies Inc. Club Hawk II	CompuAdd Corp. CompuAdd 425	Computer Market Place Inc. Ultra 486-25
Price of standard configuration	$5,449	$5,499	$10,944	$5,636	$5,795	$5,670	$4,497
Standard configuration hard disk	109MB	109MB	110MB	150MB	150MB	110MB	105MB
TESTED CONFIGURATION							
Price of tested configuration	$7,595	$8,385	$10,944	$5,636	$5,795	$5,670	$5,889
Case type	Tower	Tower	Desktop	Desktop	Tower	Small-footprint	Tower
Dimensions (HWD, in inches)	25.5 x 9.5 x 16.75	24.3 x 7.8 x 18.2	6.25 x 19.25 x 16.5	6.4 x 21.1 x 16.8	25 x 7 x 18.5	4.25 x 16.5 x 15.75	24 x 7.4 x 17.4
Motherboard manufacturer	AMI	AMI	AST	Micronics	Club	CompuAdd	A. I. R.
486 chip set manufacturer	Chips and Technologies, discrete logic	Chips and Technologies	Chips and Technologies, discrete logic	Discrete logic	VLSI	OPTI	Discrete logic
System RAM arrangement	Interleaved, page-mode	Interleaved, fast page-mode	Fast page-mode	Interleaved, page-mode	Page-mode	Page-mode	Page-mode
Wait states	0	0	0	0	0	0	0
MOTHERBOARD MEMORY							
Installed RAM	8MB	8MB	4MB	4MB	4MB	4MB	4MB
Maximum installable RAM	8MB (24MB for system)	8MB	16MB	16MB	8MB	8MB	16MB
RAM packaging (and rated speed)	SIMM (70 ns.)	SIMM (80 ns.)	SIMM (80 ns.)	SIMM (80 ns.)	SIMM (80 ns.)	SIMM (80 ns.)	SIMM (80 ns.)
Chip size	1Mb	1Mb	4 x 256Kb	1Mb	1Mb	1Mb	1Mb
ADD-IN MEMORY BOARD							
Installed RAM	None	None	None	None	None	None	None
Maximum installable RAM	16MB	16MB	32MB (2 boards)	N/A	N/A	8MB	N/A
RAM packaging (and rated speed)	SIMM (80 ns.)	SIMM (80 ns.)	SIMM (80 ns.)	N/A	N/A	SIMM (70 ns.)	N/A
Chip size	1Mb, 256Kb	1Mb	1Mb	N/A	N/A	1Mb	N/A
PROCESSOR RAM CACHE							
Cache controller	Discrete logic	Discrete logic	None	Discrete logic	Discrete logic	None	Discrete logic
Installed RAM	128K	128K	N/A	64K	64K	N/A	128K
RAM packaging (and rated speed)	DIP (35 ns.)	DIP (35 ns.)	N/A	DIP (25 ns.)	DIP (20 ns.)	N/A	DIP (35 ns.)
Chip size	64Kb	4 x 16Kb	N/A	4 x 16Kb	32Kb	N/A	32Kb
Maximum installable RAM	128K	128K	N/A	256K	256K	N/A	128K
BIOS							
BIOS version and date	AMI (April 1990)	AMI (January 1990)	AST Cupid BIOS 1.10 (January 1990)	Phoenix 0.01FI (January 1990)	AMI (December 1988)	Phoenix 486 0.10.00 (June 1989)	AMI (December 1989)
Setup in ROM	■	■	■	■	■	■	■
Password in ROM	❑	❑	■	❑	❑	❑	❑
Video shadowing/Can be disabled	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
System shadowing/Can be disabled	■ ❑	■ ❑	■ ■	■ ■	■ ■	■ ■	■ ■
HARD DISK							
Manufacturer	Maxstor	Maxstor	Imprimis	Maxstor	Data Tech	CDC	Micropolis
Disk capacity	360MB	153MB	110MB	148MB	158MB	110MB	144MB
Interface	ESDI	ESDI	IDE	ESDI	ESDI	IDE	ESDI
Controller location	Card	Card	Motherboard	Card	Card	Motherboard	Card
Controller manufacturer	Ultrastor	Ultrastor	AST	Western Digital	Data Tech	CompuAdd	Konan Ten-Time
Integrated floppy/hard disk controller	■	■	❑	■	■	■	■
Drive bays	6 half-height	6 half-height or 3 full-height	5 half-height	5 half-height; or 2 full-height, 1 half-height	6 half-height; or 2 full-height, 1 half-height	1 half-height, 2 3.5-inch	6 half-height or 3 full-height
Hard disk options	109MB (RLL); 180MB, 338MB (SCSI); 150MB, 338MB, 676MB (ESDI)	300MB, 600MB (ESDI)	320MB (ESDI)	330MB, 660MB (ESDI)	150MB (MFM); 300MB, 600MB (SCSI); 300MB, 600MB (ESDI)	None	150MB, 300MB, 600MB (SCSI); 300MB, 600MB (ESDI)
FLOPPY DISK DRIVES							
Type	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB	1.2MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB
Manufacturer	TEAC	TEAC	TEAC	TEAC	TEAC	Mitsumi	Chinon
EXPANSION BUS							
Bus speeds (MHz)	6, 9, 12	6, 12	6	8.33	8	8	8
Expansion slots	One 8-bit, six 16-bit, one 32-bit (proprietary)	Two 8-bit, five 16-bit, one 32-bit (proprietary)	One 8-bit, three 16-bit, three 16/32-bit (proprietary)	Eight 16-bit	One 8-bit, six 16-bit, one 32-bit (proprietary)	Two 8-bit, three 16-bit	Eight 16-bit

☒—Editor's Choice ■—Yes ❑—No
N/A—Not applicable: the product does not have this feature.

CSS Laboratories Inc. MaxSys 486T/25	Dataworld Inc. Data 486-25	Everex Systems Inc. Everex Step 486/25	Gateway 2000 Gateway 2000 486-25	Micro Express ME 486-25	Micro Telesis Inc. MT 486DX	Mitsuba Corp. Mitsuba 486-25	Northgate Computer Systems Inc. Northgate Elegance 486/25	Osicom Technologies Inc. Executive 486/25
$9,892	$6,265	$10,525	$4,970	$5,570	$4,999	$8,525	$5,830	$7,000
106MB	104MB	160MB	110MB	100MB	100MB	108MB	200MB	100MB
$9,892	$8,372	$11,495	$5,295	$7,197	$6,299	$8,695	$7,345	$7,250
Tower	Desktop	Desktop	Desktop	Tower	Small-footprint	Desktop	Tower	Desktop
25.25 x 7.5 x 23.75	6.75 x 21 x 16.25	6.5 x 21 25 x 16.75	6.5 x 21 x 16.5	25.5 x 9.3 x 18.5	7 x 14.75 x 16.25	6.5 x 21 x 16.5	26 x 7.4 x 16	6.5 x 19.5 x 16.5
CSS	Micronics	Everex	Micronics	AMI	M. A. Laboratories	Micronics	Northgate	Osicom
Discrete logic	Chips and Technologies, discrete logic	Discrete logic	Chips and Technologies	Chips and Technologies, discrete logic	Discrete logic	Chips and Technologies, discrete logic	Discrete logic	Headlands Technology
Page-mode	Fast page-mode	Page-mode	Interleaved	Page-mode	Interleaved, page-mode	Fast page-mode	Page-mode	Interleaved
0	0	0	0	0	0, 1	0	0	0
N/A	4MB	N/A	4MB	4MB	N/A	4MB	4MB	4MB
N/A	16MB	N/A	16MB	8MB	N/A	16MB	8MB	8MB
N/A	SIMM (80 ns.)	N/A	SIMM (70 ns.)	SIMM (70 ns.)	N/A	SIMM (80 ns.)	SIMM (80 ns.)	SIMM (80 ns.)
N/A	1Mb	N/A	1Mb	1Mb	N/A	1Mb	1Mb	1Mb
4MB	None	4MB	None	None	4MB	None	None	None
16MB	N/A	32MB	N/A	16MB	16MB	N/A	N/A	N/A
DIP (80 ns.)	N/A	SIMM (80 ns.)	N/A	DIP (80 ns.)	SIMM (80 ns.)	N/A	N/A	N/A
1Mb	N/A	1Mb	N/A	1Mb	1Mb	N/A	N/A	N/A
None	Discrete logic	Everex	Proprietary	Discrete logic	None	Discrete logic	Discrete logic	None
N/A	256K	128K	64K	128K	N/A	64K	256K	N/A
N/A	DIP (25 ns.)	DIP (25 ns.)	DIP (25 ns.)	DIP (35 ns.)	N/A	DIP (25 ns.)	DIP (20 ns.)	N/A
N/A	8x32Kb	64Kb	32Kb	64Kb	N/A	8x8Kb	64Kb	N/A
N/A	256K	128K	256K	128K	N/A	256K	256K	N/A
Phoenix 1.00.04 (January 1988)	Phoenix 1.10.10F (January 1988)	AMI (May 1990)	Phoenix 1.10.10F (January 1988)	AMI (April 1990)	Phoenix 0.10.02 (January 1988)	Phoenix 1.10.10F (January 1988)	AMI (December 1989)	Osicom 2.10 (May 1990)
■	■	■	■	■	■	■	■	■
❑	❑	❑	❑	❑	❑	❑	❑	❑
■ ■	■ ■	❑	■ ■	■ ■	■ ■	■ ■	❑ / ❑	■ ■
■ ■	■ ■	■ ■	■ ■	■ ❑	■ ■	■ ■	❑ / ❑	■ ❑
CDC 106MB ESDI Card	Micropolis 161MB ESDI Card	Seagate 330MB ESDI Card	Imprimis 150MB ESDI Card	Seagate 150MB ESDI Card	MicroScience 160MB ESDI Card	Toshiba 108MB RLL Drive	Maxstor 200MB IDE Drive	Seagate 151MB ESDI Card
Adaptec	Perceptive Solutions	DPT	Ultrastor	DPT	DPT	Data Tech	Seagate	Western Digital
■	■	■	■	■	■	■	■	■
10 half-height	5 half-height	1 full-height, 3 half-height	5 half-height	6 half-height	3 half-height, 2 3.5-inch	5 half-height	7 half-height; or 3 full-height and 1 half-height	5 half-height
106MB, 209MB, 376MB, 766MB, 1.2GB (SCSI); 182MB, 383MB (ESDI)	105MB, 209MB (IDE); 322MB (ESDI)	90MB, 160MB (ESDI)	110MB, 300MB, 600MB (ESDI)	100MB (MFM); 100MB, 200MB (IDE); 100MB, 300MB, 750MB (ESDI)	150MB (IDE); 100MB, 330MB, 720MB (ESDI)	144MB, 330MB (ESDI)	100MB (IDE); 300MB, 600MB (SCSI); 150MB, 300MB, 600MB (ESDI)	100MB (IDE); 150MB, 300MB, 600MB (ESDI)
1.2MB TEAC	1.2MB TEAC	1.2MB TEAC	1.2MB, 1.44MB TEAC	1.2MB, 1.44MB TE Data/Toshiba	1.2MB, 1.44MB Newtronics	1.2MB Epson	1.2MB, 1.44MB Mitsumi	1.2MB Panasonic
8 Two 8-bit,eight 16-bit, two 32-bit (proprietary)	8.3 Eight 16-bit	6.25, 8.3, 12.5 One 8-bit, six 16-bit, one 32-bit (proprietary)	8.34 Eight 16-bit	8 One 8-bit, six 16-bit, one 32-bit (proprietary)	8 Two 8-bit, five 16-bit, one 32-bit (proprietary)	8.3 Eight 16-bit	8 One 8-bit, seven 16-bit	8 Two 8-bit, six 16-bit

CONTINUES

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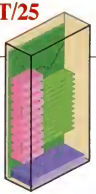
CIRCLE 211 ON READER SERVICE CARD

CSS LABORATORIES INC.

MaxSys 486T/25

by Bruce Brown



If you're in the market for a 25-MHz 486 file server or multiuser system with lots of room for drives and expansion cards, your search may end with CSS Laboratories' MaxSys 486T/25. While most of its high-quality components can be found on the standard off-the-shelf shopping list, the system's ten drive bays, twelve interface card slots, and 400-watt power supply distinguish it from much of the competition.

This is—literally—not a machine to take lightly. To provide room for all the cards and drives this computer can hold, plus space for air circulation, the MaxSys's tower-style case is big: 25.25 by 7.5 by 23.75 inches. It looks and feels rugged. The price tag is also substantial: *PC Magazine*'s standard configuration, which we tested, lists for $9,892. This includes a CDC 106MB 18-millisecond hard disk, a 5.25-inch floppy disk drive, an Adaptec ESDI floppy/hard disk controller, a Western Digital/Paradise VGA Professional 16-bit card and a fine NEC MultiSync 3D monitor, one parallel and two serial ports, a 101-key Futaba keyboard, and DOS 3.3. A basic configuration with 4MB of RAM and just a keyboard—no disk drives at all, no controller, video adapter, monitor, ports, or software—retails for $7,212.

With 400 watts of power, 10 drive bays, and 12 interface card slots, the MaxSys 486T/25 from CSS Laboratories shows its prowess as a multiuser system or file server. All this power comes in a hefty 25.25- by 7.5- by 23.75-inch case, at $9,892 for the standard configuration.

When it comes to system expansion, the MaxSys lives up to its name. Up to ten half-height drives can be mounted in the machine, all in a vertical stack facing the front, and each capable of using removable media. The power supply extends across the entire bottom of the system and includes eight device power leads—which should be enough, as a full machine is likely to have one or two full-height drives. The expansion slot lineup includes two 8-bit slots and eight 16-bit, in addition to proprietary memory slots. Even a packed system should run cool enough with the ample power supply, top- and bottom-mounted fans, and the extra air space inside the case.

Up to ten half-height drives can be mounted in the CSS MaxSys in a vertical stack facing the front, and all are capable of using removable media.

CSS makes its own motherboard, using Phoenix's ROM BIOS and largely discrete motherboard logic chips. It seems that more 486 manufacturers are using their own wired-in logic, which is not as risky today as it was when Chips and Technologies made a name for itself providing chip sets for 286 and 386 systems. The CSS system has no provision for RAM caching beyond the 486 chip's internal 8K cache, but there is a slot for a Weitek 4167 math coprocessor.

All system memory in the MaxSys is mounted on memory cards. (In general, as much memory as possible ought to be mounted on the motherboard, but giving up space to memory cards isn't much of a loss in a machine with as many slots as the MaxSys.) The standard configuration includes a single card that plugs into one of the two proprietary 32-bit expansion slots, holding up to 8MB of 80-nanosecond page-mode memory using DIP chips. To build beyond 8MB toward the system's 32-bit 16MB maximum, you need to buy a second memory card, which is a $280 option (without any RAM). If you know you'll need more memory in the future, it's a good idea to invest in the proprietary card when you buy the system. CSS sells memory in 4MB bunches for $528—a little higher than the average street price—but you can always shop around later for cheaper chips.

The CSS system fared well on the benchmark tests, with its Conventional Memory test score among the fastest. While hard disk and video scores were on the low side, they were still well within expectations for the 25-MHz 486 class.

CSS is a direct-sales company that also sells through VARs. The standard warranty covers parts and labor for one year and provides for shipping of replacement parts, but the company loses points for providing telephone support only via toll calls. Optional on-site support is available: a one-year contract, with service provided by KES Engineering, costs $282.

The MaxSys is obviously overkill for most single users, but the ample provisions for drive and add-on board expansion make this system a fine choice in network or multiuser applications. If you need to hang lots of goodies in a 486 case, the MaxSys has as many hangers as you're likely to find.

PC MAGAZINE FACT FILE

MaxSys 486T 25
CSS Laboratories Inc., 1641 McGaw Ave., Irvine, CA 92714; (714) 852-8161.
List Price: With 4MB RAM, $7,212; with 106MB hard disk, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, VGA monitor, one parallel and two serial ports, DOS 3.3, $9,892.
In Short: This tower-style machine is clearly intended for network or multiuser applications. The expansion capacity is indicated by its ten drive bays and twelve card slots, along with a 400-watt power supply with two fans and eight power leads. It's not inexpensive, but if you need room for lots of components, you must see this computer.

CIRCLE 424 ON READER SERVICE CARD

25-MHz 486-BASED PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	PC Connections/ Destiny Computers Inc. Destiny 486/25	Polywell Computers Inc. Polywell 486/25	SAI Systems Laboratories Inc. SAI 486/25	Swan Technologies Swan 486/25	Syntrex Inc. Syntrex 486/25C	Transource Computers Verxion 486	☒ Tri-Star Computer Corp. Tri-Star 486/25	Twinhead Corp. Twinhead Superset 600/425
Price of standard configuration	$8,945	$6,150	$5,495	$6,024	$11,119	$5,295	$5,555	$6,995
Hard disk capacity	100MB	100MB	100MB	110MB	150MB	100MB	207MB	104MB
TESTED CONFIGURATION								
Price of tested configuration	$9,500	$7,250	$5,495	$6,599	$11,900	$5,575	$6,995	$7,410
Case type	Tower	Tower	Desktop	Desktop	Tower	Tower	Tower	Small-footprint
Dimensions (HWD, in inches)	19.25 x 14.0 x 18.0	25.7 x 8.6 x 19.7	6 x 21 x 16.5	6.5 x 21 x 16.5	24.5 x 15 x 22	25 x 7.5 x 16.75	23.5 x 8.5 x 25	5.1 x 15.75 x 15.75
Motherboard manufacturer	A. I. R.	Polywell	A. I. R.	Micronics	Syntrex	A. I. R.	Tri-Star	Twinhead
486 chip set manufacturer	Chips and Technologies, discrete logic	Chips and Technologies, discrete logic	Chips and Technologies	Chips and Technologies	Chips and Technologies	Discrete logic	Discrete logic	Chips and Technologies
System RAM arrangement	Page-mode	Interleaved, page-mode	Interleaved	Fast page-mode	Interleaved, page-mode	Interleaved, fast page-mode	Row/column	Interleaved, page-mode
Wait states	0	0	0	0	0	0	0	0
MOTHERBOARD MEMORY								
Installed RAM	4MB	8MB	8MB	4MB	4MB	4MB	4MB	8MB
Maximum installable RAM	16MB	16MB	16MB	16MB	16MB	16MB	8MB	8MB
RAM packaging (and rated speed)	SIMM (80 ns.)	SIMM (80 ns.)	SIMM (80 ns.)	SIMM (80 ns.)	SIMM (80 ns.)	SIMM (80 ns.)	SIMM (80 ns.)	SIMM (80 ns.)
Chip size	1Mb	1Mb	1Mb	1Mb	1Mb	1Mb	1Mb	1Mb
ADD-IN MEMORY BOARD								
Installed RAM	None	None	None	None	None	None	None	None
Maximum installable RAM	N/A	N/A	N/A	N/A	N/A	N/A	8MB	8MB
RAM packaging (and rated speed)	N/A	N/A	N/A	N/A	N/A	N/A	SIMM (80 ns.)	SIMM (80 ns.)
Chip size	N/A	N/A	N/A	N/A	N/A	N/A	1Mb	1Mb
PROCESSOR RAM CACHE								
Cache controller	Discrete logic	Discrete logic	Proprietary PAL	Discrete logic	Discrete logic	Discrete logic	Discrete logic	Discrete logic
Installed RAM	128K	128K	128K	64K	32K	128K	256K	64K
RAM packaging (and rated speed)	DIP (35 ns.)	DIP (25 ns.)	DIP (25 ns.)	DIP (25 ns.)	DIP (30 ns.)	DIP (35 ns.)	DIP (20 ns.)	Quad Flat Packs (25 ns.)
Chip size	256Kb	256Kb	32Kb	8x8Kb	32Kb	4 x 32Kb	256Kb	16x64Kb
Maximum installable RAM	128K	128K	128K	256K	32K	128K	256K	64K
BIOS								
BIOS version and date	AMI (December 1989)	AMI (December 1989)	AMI (December 1989)	Phoenix 1.10.10F (January 1988)	Phoenix 1.10.02 (January 1988)	AMI (December 1989)	AMI (September 1989)	Phoenix 1.10 22AC (January 1988)
Setup in ROM	■	■	■	■	■	■	■	■
Password in ROM	❑	❑	❑	❑	❑	❑	❑	❑
Video shadowing/Can be disabled	■ / ■	■ / ■	■ / ■	■ / ■	❑ / ❑	■ / ■	❑	■ / ■
System shadowing/Can be disabled	■ / ■	■ / ■	■ / ■	■ / ■	❑ / ❑	■ / ■	❑	■ / ■
HARD DISK								
Manufacturer	Maxstor	Seagate/CDC Wren II	Imprimis	Imprimis	Maxstor	Seagate	Maxstor	Imprimis
Disk capacity	150MB	155MB	150MB	170MB	150MB	150MB	207MB	142MB
Interface	ESDI	ESDI	ESDI	SCSI	ESDI	ESDI	IDE	IDE
Controller location	Card	Card	Card	Card	Card	Card	Card, drive	Motherboard
Controller manufacturer	NCL	Ultrastor	Ultrastor	Adaptec	Western Digital	Western Digital	Western Digital	Twinhead
Integrated floppy/hard disk controller	■	■	■	■	■	■	■	❑
Drive bays	6 half-height	5 half-height	5 half-height	5 half-height	10 half-height or 5 full-height	1 full-height, 4 half-height	5 half-height, 1 3.5-inch	1 half-height, 2 one-third-height, 1 3.5-inch
Hard disk options	150MB (MFM); 300MB (ESDI)	100MB, 200MB (IDE); 100MB, 200MB, 307MB, 613MB, 1GB (SCSI);337MB, 676MB (ESDI)	100MB (RLL); 300MB, 600MB (ESDI)	110MB, 150MB, 330MB, 660MB (SCSI) (ESDI)	150MB, 300MB, 600MB (SCSI); 300MB, 600MB	300MB, 600MB (ESDI)	150MB, 338MB, 660MB (ESDI) (IDE)	100MB, 150MB, 200MB, 300MB
FLOPPY DISK DRIVES								
Type	1.2MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB
Manufacturer	Chinon	TEAC	TEAC	TEAC/Sony	Mitsubishi/Sony	TEAC	Mitsumi	Canon
EXPANSION BUS								
Bus speeds (MHz)	8	8	8	8.3	8	8	10	8

☒—Editor's Choice ■—Yes ❑—No
N/A—Not applicable: the product does not have this feature.

CONTINUES

G/Ethernet with a new twist...

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THE INTENSE!... FACTS

TOUCHE 386/33	Gateway	Northgate
CPU-Upgrades to 486	No	No
Motherboard Manufacturer-AMI	?? Changes??	?? Changes??
RAM-28 MB max.	16 MB max.	16 MB max.
Hard Drive-151MB or 200MB	150 MB	200 MB
Video-Sony 1304 "EDITOR'S CHOICE" NON-INTERLACED	Tatung (Generic) INTERLACED	NEC-3D INTERLACED
Tower-NO CHARGE	$200 Extra	NO CHARGE
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CIRCLE 533 ON READER SERVICE CARD

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25-MHz 486-BASED PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

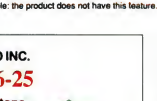
	ACMA Computers Inc. ACMA 486/25	Amax Engineering Corp. Amax 486/25 Power Station	AST Research Inc. AST Premium 486/25	Blackship Computer Systems Inc. Blackship 486/25	Club American Technologies Inc. Club Hawk II	CompuAdd Corp. CompuAdd 425	Computer Market Place Inc. Ultra 486-25
EXPANSION BUS							
Slots left free after hard/floppy disk drives, video, one parallel and two serial ports are installed	5	5	5	5	5	4	5
Ports originate on motherboard	❑	❑	■	❑	❑	■	❑
VIDEO							
Display circuitry location	Card	Card	Card	Card	Card	Card	Card
Interface	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit
Manufacturer	ATI	ATI	AST	Orchid	Everex Viewpoint	CompuAdd	Ztech
Chip set manufacturer	ATI	ATI	Paradise	Tseng Labs	Zymos	Tseng	Western Digital
KEYBOARD							
Manufacturer	MaxiSwitch	MaxiSwitch	AST	Key Tronic	Key Tronic	Key Tronic	Key Tronic
Number of keys	101	101	101	101	101	101	101
Number of function keys	12	12	12	12	12	12	12
Keyboard cable length (inches)	63	66	120	84	94	60	94
SOFTWARE AVAILABLE							
OS/2	None	1.1 ($699)	1.1 ($340)	None	None	1.21 ($250)	1.1 ($237)
Microsoft Windows	3.0 ($99)	2.11 ($165)	None	None	None	3.0 (standard)	2.11 ($129)
Disk caching software	❑	■	■	❑	■	❑	■
Expanded memory manager	❑	■	❑	■	❑	❑	❑
Other	None	None	None	None	None	*DOS Helpl, PC FullBack, PC PaintBrush*	None
MISCELLANEOUS							
Coprocessor supported	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	None	Weitek 4167
Physical features:							
Power supply (watts)	450	250	220	230	250	150	220
Number of device connectors	5	6	4	4	6	5	4
Keyboard lock	Front	Front	None	Front	Front	None	Front
Case lock	None	None	Rear	Front	None	None	None
Power-on switch	Front	Front	Right	Right	Front	Right	Front
Reset switch	Front	Front	Front	Front	Front	None	Front
Warranty	1 year parts, 2 years labor	1 year	1 year	1 year	1 year	1 year	1 year
Service	Express parts swap; on-site optional	4 months on-site, then return to dealer	Return to dealer, manufacturer, or service center	Return to dealer	Return to depot or dealer	On-site	Return to depot or dealer
FCC certification class	A	A	B	A B (pending)	B	A	A

❑—Editor's Choice ■—Yes ❑—No
N/A—Not applicable: the product does not have this feature.

DATAWORLD INC.

Data 486-25

by M. David Stone



In most ways, the Data 486-25 is a typical desktop system, built from an assemblage of off-the-shelf parts. Yet thanks to a careful selection of parts, Dataworld has built a system that offers a low price and better-than-average performance.

In *PC Magazine*'s standard configuration—with 4MB RAM, a 104MB hard disk, one floppy disk drive, VGA card and color monitor, and two parallel and two serial ports—the Data 486-25 is just $6,265. The unit provided for review carries a price tag of $8,372—which is still low, considering that it includes 256K of 25-nanosecond system cache, a Micropolis 161MB 16-millisecond hard disk, and a caching disk controller with 4MB of RAM. All prices include one year of on-site service through TRW.

The Micronics motherboard in the system includes the 80486-25 chip, plus a combination of discrete logic and a chip from the Chips and Technologies chip set, and a socket—empty in the tested system—for a Weitek 4167. As tested, the

FACT FILE

Data 486-25
Dataworld Inc., 3733 San Gabriel River Pkwy., Pico Rivera, CA 90660; (800) 736-3282; (213) 695-3777.
List Price: With 4MB RAM, 64K processor RAM cache, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, Hercules-compatible monitor, two parallel and two serial ports, $4,995; with 104MB hard disk, VGA monitor, DOS 3.3 or 4.01, $6,265; with 256K processor RAM cache, 161MB hard disk, disk controller with 4MB cache, $8,372.
In Short: The Data 486-25 offers better-than-average price and performance in a classic case.

CIRCLE 425 ON READER SERVICE CARD

CSS Laboratories Inc. MaxSys 486T/25	Dataworld Inc. Data 486-25	Everex Systems Inc. Everex Step 486/25	Gateway 2000 Gateway 2000 486-25	Micro Express ME 486-25	Micro Telesis Inc. MT 486DX	Mitsuba Corp. Mitsuba 486-25	Northgate Computer Systems Inc. Northgate Elegance 486/25	Oscom Technologies Inc. Executive 486/25
8	5	5	5	5	4	5	6	4
❑	❑	■	❑	❑	❑	❑	■	❑
Card	Card	Card	Card	Card	Card	Card	Card	Card
16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit
Western Digital	Orchid	Everex	ATI	Pixel	Western Digital	Mitsuba	HeadLand Technology	Western Digital
Paradise	Tseng Labs	Zymos	ATI	Trident	Paradise	Trident	G2	Western Digital
Futaba	Focus Electronic	Everex	Key Tronic	Chicony	SIC Research	Honeywell	Northgate	Mitsumi
101	101	101	101	101	101	101	119	101
12	12	12	12	12	12	12	24	12
48	90	84	60	72	60	103	96	96
None	None	1.1 ($340)	1.2 ($295)	1.1 ($279)	1.2 ($325)	None	1.1 ($249)	None
None	None	None	3.0 ($75)	2.11 ($149)	None	None	3.0 (standard)	None
❑	❑	■	❑	■	❑	❑	❑	❑
❑	■	■	❑	■	■	■	❑	❑
None	None	None	None	None	None	None	None	None
Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	None
400	200	200	200	230	200	220	220	150
8	5	4	6	4	4	4	4	5
Front	Front	Front	Front	Front	Front	Front	Front	Front
None	None	Front	None	None	None	None	None	None
Front	Right	Right	Right	Front	Front	Right	Front	Right
Front	Front	Front	Front	Front	Front	Front	Front	Front
1 year	1 year	1 year	1 year parts, unlimited labor	2 years	13 months	1 year	1 year	1 year
Express parts swap, or return to dealer, or manufacturer	On-site	Express parts swap; on-site service	1 year on-site, then return to dealer	Express parts swap, or return to manufacturer	Express parts swap, or return to manufacturer	Return to dealer	Return to depot or dealer	On-site
A	B	A	A	B	A (B pending)	A	B	A

CONTINUES

unit came with a 386 version of the Phoenix BIOS. According to Dataworld, the 486 BIOS became available too late for this review. To its credit, the company is automatically sending the updated BIOS to anyone who bought the system with the 386 BIOS installed. Although swapping the chips is easy enough to do on your own, TRW will provide the service if necessary.

The motherboard has eight 16-bit slots, three of which were filled on the tested unit—with Orchid Technology's ProDesigner II VGA board, PSI's hyperStore-1600 disk controller, and a parallel/serial card. All memory goes in SIMM sockets, conveniently located between the slots and power supply. The review system came with four 1MB SIMMs, using 80-ns. chips. A total of 16 sockets allow for a maximum of 16MB of RAM.

Dataworld is automatically sending the 486 BIOS to anyone who bought the system with the 386 BIOS installed.

Also on the motherboard is the external cache and discrete logic to control it. Dataworld sells the system with a minimum of 64K static RAM cache, which can be expanded to 128K or 256K. (Dataworld does not offer a 128K option; you would have to buy it elsewhere.)

As already mentioned, the review unit had 256K of cache, a $285 option. But the results on PC Labs' tests suggest that the larger cache yields little benefit when running under DOS. In fact, on most of the processor and memory tests, the difference

25-MHz 486-BASED PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	PC Connections/ Destiny Computers Inc. Destiny 486/25	Polywell Computers Inc. Polywell 486/25	SAI Systems Laboratories Inc. SAI 486/25	Swan Technologies Swan 486/25	Syntrex Inc. Syntrex 486/25C	Transource Computers Venzon 486	☒ Tri-Star Computer Corp. Tri-Star 486/25	Twinhead Corp. Twinhead Superset 600/425
EXPANSION BUS								
Expansion slots	Eight 16-bit	Eight 16-bit	Eight 16-bit	Eight 16-bit	Three 8-bit, seven 16-bit	Eight 16-bit	Seven 16-bit, one 32-bit (proprietary)	Four 16-bit
Slots left free after hard/floppy disk drives, video, one parallel and two serial ports are installed	5	5	5	5	6	5	6	4
Ports originate on motherboard	❑	❑	❑	❑	■	❑	■	■
VIDEO								
Display circuitry location	Card	Card	Card	Card	Card	Card	Card	Motherboard
Interface	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit
Manufacturer	Orchid	Orchid	Paradise	Swan (Tseng Labs)	Western Digital	Western Digital	Renaissance	Twinhead
Chip set manufacturer	Tseng Labs	Tseng Labs	Paradise	Tseng Labs	Paradise	Paradise	Texas Instruments	Paradise
KEYBOARD								
Manufacturer	BTC	Key Tronic	Focus Electronic	NMB Technology	Honeywell	Monterey	Nan-Tan	Focus
Number of keys	101	101	101	101	101	101	101	101
Number of function keys	12	12	12	12	12	12	12	12
Keyboard cable length (inches)	87	72	60	112	72	80	84	76
SOFTWARE AVAILABLE								
OS/2	None	1.2 ($325)	None	None	None	None	None	None
Microsoft Windows	None	3.0 ($149)	3.0 ($149)	3.0 ($99)	None	None	None	1.0 ($150)
Disk caching software	❑	■	❑	❑	❑	❑	❑	■
Expanded memory manager	❑	■	❑	■	■	❑	❑	❑
Other	None	None	*SP-Word*	*QA Plus*	None	None	None	None
MISCELLANEOUS								
Coprocessor supported	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	None	Weitek 4167	Weitek 4167	Weitek 3167
Physical features:								
Power supply (watts)	200	200	200	200	275	230	250	145
Number of device connectors	4	4	4	5	6	5	6	5
Keyboard lock	Front	Front	Front	Front	Front	Front	Front	Front
Case lock	None	None	None	None	None	Front	None	None
Power-on switch	Front	Front	Right	Right	Front, rear	Front	Front	Front
Reset switch	Front	Front	Front	Front	None	Front	Front	Front
Warranty	1 year	1 year parts; 2 years motherboard; 5 years labor	1 year parts, 3 years labor	1 year	1 year dealer depot	1 year	2 years	1 year
Service	On-site	1 year on-site, then return to manufacturer	60 days express parts swap; then return to dealer	On-site	Return to dealer or depot; on-site optional	On-site	Express parts swap; on-site service	On-site
FCC certification class	A	A	A	B	A	A	A	B

☒—Editor's Choice ■—Yes ❑—No
N/A—Not applicable: the product does not have this feature.

ENDS

between the fastest and slowest systems was small enough to be virtually meaningless—even though some systems had no external cache whatsoever.

It's worth noting that the Data 486-25 results for processor and memory tests were in the top half of the group, making any difference between it and the fastest systems even less significant. Performance on the video tests was midrange or better.

Scores on the disk tests were among the best of any system, thanks largely to the hyperStore-1600 caching controller. The controller's four SIMM sockets held the maximum 4MB cache. By the time you read this, a daughterboard that will allow an additional 16MB should be available.

The Data 486-25 PC's results for the processor and memory tests were in the top half of the group.

An unusual feature on the hyperStore controller is that it uses a daughterboard for the disk drive interface, so you can change to a different drive type by changing the daughterboard. Even more interesting is that you can have up to four daughterboards installed, and can control SCSI, ESDI, MFM, and RLL drives all from one controller. The review system came with the ESDI daughterboard.

The Data 486-25's physical design is standard fare. The bay arrangement offers five half-height bays in stacks of three and two, with three bays accessible. Unfortunately, the chassis is not as rigid as it should be. The motherboard itself has

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CIRCLE 363 ON READER SERVICE CARD

Presented in a standard AT-sized case with five drive bays, Dataworld's Data 486-25 offers good overall performance for its $6,265 price tag. The availability of on-site service adds further value.

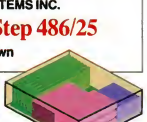
solid support, but you can easily flex the back panel and potentially pop the boards out of their slots.

Judged strictly by price and performance, the Data 486-25 is a better-than-average value—especially after you factor in the one-year on-site service. The flexibility in the chassis may be a defect; but if you tend to plant your computers in one spot and rarely move them, this potential problem should never turn into a real one.

EVEREX SYSTEMS INC.

Everex Step 486/25

by Bruce Brown



Combining an external 128K cache with the 486 chip's internal 8K cache, fast page-mode memory, and a DPT intelligent caching hard disk controller with 4.5MB of its own cache memory, the Everex Step 486/25 is ready to run right up the charts for top-scoring benchmark test numbers. It therefore may justify a price tag that soars above many other comparable models.

At 6.5 by 21.25 by 16.75 inches, the Step 486/25 has room inside for five half-height drives and is the same size as most desktop AT-class and 386-based computers. The price is higher than that of many other 486s, however. Our dressed-to-kill standard-configuration unit came to a rousing $11,495, with a DPT 4.5MB cache controller, a 330MB Seagate 14.5-millisecond hard disk, Everex Viewpoint 16-bit Super VGA display adapter, and Everex multisynchronous 14-inch Super VGA monitor. And that was in addition to the features of the $8,999 basic configuration: 4MB RAM, 128K external cache, a 5.25-inch TEAC floppy disk drive, one parallel and two serial ports, 101-key keyboard, DOS 3.3, and utility software (but no hard disk or video setup). Fortunately, Everex manufactures and sells computers largely through VARs, who often bundle the systems with other hardware and custom software.

The Everex Step 486/25 is ready to run right up the charts for top-scoring benchmark test numbers.

Everex makes the motherboard in this computer using discrete logic circuitry and chips for the 486 chip set and AMI ROM BIOS chips. The system can be run at 8 or 25 MHz with the expansion bus set at 6.25, 8.3, or 12.5 MHz. The system defaults are set to run the CPU at 25 MHz and the bus at 8.3 MHz. In addition to the 486 chip's on-board floating-point math coprocessor, the Step 486/25 has a socket for a Weitek 4167. RAM shadowing is available for the system ROM BIOS only.

None of Step 486/25's system memory fits on the motherboard; therefore, the memory card takes up the single proprietary 32-bit expansion slot. Up to 16MB can be put on the memory card using 1MB 80-nanosecond SIMMs. There are also one 8-bit and six 16-bit slots.

The Step 486/25 has five half-height drive bays. With the full-height 330MB hard disk and a single floppy disk drive, there is still room for an additional full-height or two half-height hard disks, or for a second floppy drive and a half-height tape backup unit. The 200-watt power supply has four storage-device power leads.

The $10,125 price tag for Everex's Step 486/25 may soar above many others, but the vendor's reputation for excellent performance and the extra hardware and software VARs often throw in may justify the expense.

Everex's standard warranty is for one year on parts and labor. It includes on-site service via NCS, with service available within a 100-mile radius of any NCS center, encompassing approximately 95 percent of the population of the United States.

The Everex Step 486/25 is a fast, full-sized machine, with an FCC Class B rating. It's priced up there with the majors, but with Everex's reputation for performance and the high-powered components included, you certainly get what you pay for. If the drive expansion capabilities are sufficient, this machine is fine for use as a network file server. Otherwise, the Step 486/25 is a dream for those who are looking for a speedy single-user machine and who don't mind sharing desk space with the computer.

FACT FILE

PC MAGAZINE

Everex Step 486/25
Everex Systems Inc., 48431 Milmont Dr., Fremont, CA 94538; (415) 683-2246.
List Price: With 4MB RAM, 128K processor RAM cache, 1.2MB 5.25-inch floppy disk drive, one parallel and two serial ports, DOS 3.3, and utility software, $8,999; with 90MB hard disk, VGA monitor, $10,125; with 330MB hard disk, $11,495.
In Short: The Everex Step 486/25 is a fine, fast desktop machine. While it's not cheap, the Step 486/25 continues the company's tradition of performance-oriented computers. If you're in the market for a server or for an ultrafast single-user machine, you should check the specs on this one.

CIRCLE 426 ON READER SERVICE CARD

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Recommended Memory	640K	1-2 meg
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Price	$99.95	$1495.00

*Byte Excel benchmark, 1000 iterations on 20 MHZ 386.

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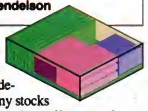
CIRCLE 308 ON READER SERVICE CARD

GATEWAY 2000

Gateway 2000 486-25

by Edward Mendelson



The Gateway 2000 486-25 scores points for its sensible design: the company stocks the system with the best off-the-shelf parts for high compatibility and unlimited expansion and customization options. In addition, Gateway prices its machine at a reasonable cost: $4,970 for our standard configuration, or $5,295 for the tested system (which added a second floppy disk drive and upgraded the hard disk capacity from 110MB to 150MB).

The Gateway 2000 486-25 is constructed from high-quality parts that are likely to work well with any software or hardware you use. The Micronics motherboard uses a tried-and-true Phoenix BIOS dating from as far back as January 1988. Along with 64K of 25-nanosecond cache RAM, you get 4MB of system RAM in the form of 1MB 70-ns. SIMMs; you can fit 16MB on the motherboard without wasting a slot. When 4MB SIMMs become available, you'll be able to pack 64MB of system RAM on the motherboard. If you want to install a Weitek coprocessor, a convenient socket awaits it.

The tested unit was supplied with a 5.25-inch and a 3.5-inch floppy disk drive, along with a full-height 150MB ESDI hard disk made by Seagate (this is from the series of top-quality drives that Seagate used to market under the name Imprimis). You also get an Ultrastor disk controller (probably the best noncaching model available) with a 32K buffer, an ATI super VGA card with 512K of RAM, a VGA monitor, a Key Tronic 101-key keyboard, DOS, and even *Microsoft Windows* 3.0 and a mouse.

Economical and sturdy, the Gateway 2000 486-25 comes stocked with some of the most popular off-the-shelf parts, including a Micronics motherboard, Seagate 110MB hard disk, Ultrastor disk controller and even extra software like *Windows* 3.0, for only $4,970.

FACT FILE

Gateway 2000 486-25
Gateway 2000, 610 Gateway Dr., North Sioux City, SD 57049; (800) 523-2000, (605) 232-2000.
List Price: With 4MB RAM, 110MB hard disk, 1.2MB 5.25-inch floppy disk drive, VGA monitor, one parallel and two serial ports, one game port, DOS 4.01, *Microsoft Windows* 3.0, mouse, $4,970; with 150MB hard disk, 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, $5,295.
In Short: The Gateway 2000 486-25 is a well-built desktop machine with standard parts. Two trivial glitches: BIOS shadowing is disabled through motherboard switches, not software, and the turbo switch does nothing. Otherwise, this is a solid, troublefree design.

CIRCLE **427** ON READER SERVICE CARD

Few 486 machines stand out on the basis of performance speed; in PC Labs' benchmark tests, the Gateway 2000 486-25 performed in the upper middle of a close range of competitors. What does stand out is the overall quality of the machine's construction. The I/O ports are on an expansion card, not the motherboard, but the second serial port and the game port are thoughtfully mounted on extra openings in the back of the case so that they don't take up a second slot (as they do on many competing machines). All ports are labelled, and a 25- to 9-pin adapter cable for the second serial port is provided.

The case is a sturdy American-made model with the normal array of keyboard lock, reset button, and turbo switch on the front. But the turbo switch doesn't do anything; if you want to change the operating speed from 25 to 6 or 8 MHz, you have to use a supplied program. Surprisingly, Gateway 2000 has no plans to replace the front panel with one that omits the misleading switch. Video and BIOS shadowing is standard, but if you want to disable this feature (as you should if you use *QEMM-386* or *386MAX*), you have to set switches on the motherboard.

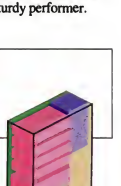
In the front section of the case that normally holds the speaker you'll find a second fan. (The speaker itself is mounted above the hard disk bay.) The vendor reports that this was added to prevent the overheating that occurred in earlier models that used a different brand of motherboard. Because the Micronics board currently used doesn't need the extra cooling, the second fan may be omitted from machines shipping by the time you read this.

The Gateway 2000 486-25 is both economical and solidly built. If you can live with a turbo switch that doesn't do anything and you don't mind disabling BIOS shadowing from the motherboard, you'll find it a reliable and sturdy performer.

MICRO EXPRESS

ME 486-25

by Alfred Poor



The ME 486-25 from Micro Express is one alternative you should definitely consider if you want high performance at a good price.

Micro Express is doing its best to grab your attention. The $5,570 price tag for *PC Magazine*'s standard configuration with a 100MB hard disk and a color VGA display is aggressively low. The tested unit, which showed up in PC Labs decked out with a 150MB Seagate ESDI hard disk driven by a DPT disk controller with a 4.5MB on-board cache, a Pixel display adapter, and a NEC MultiSync 2A monitor, was still only $7,197. And unlike some other low-cost units, Micro Express's $3,999 basic configuration includes 4MB of system memory. Anything less is simply unrealistic for most of today's RAM-hungry operating systems and applications.

The ME 486-25's low cost does not mean low performance. All its competitors turned in roughly similar numbers on PC Labs' processor benchmark tests; the Micro Express garnered average or better scores in this arena. And thanks to the caching disk controller, the ME 486-25 boasted some of the best disk speeds of the field.

The system is built around the American Megatrends motherboard used by

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Price		$495	$495	$595	$495	$495	$495
Performance							
Formula analysis	(100)	Good	Good	Good	Good	Excellent	Good
Compatibility	(62)	Excellent	Excellent	Excellent	Good	Very Good	Very Good
Speed	(75)	Very Good	Very Good	Very Good	Satisfactory	Very Good	Satisfactory
Database	(75)	Excellent	Satisfactory	Very Good	Very Good	Very Good	Very Good
Graphics	(75)	Excellent	Poor	Good	Good	Good	Very Good
Output	(50)	Very Good	Very Good	Satisfactory	Good	Excellent	Good
Macros	(38)	Excellent	Good	Good	Good	Excellent	Good
Consolidation and linking	(50)	Excellent	Satisfactory	Excellent	Satisfactory	Very Good	Very Good
Capacity	(50)	Very Good	Very Good	Very Good	Very Good	Good	Good
Documentation	(75)	Excellent	Excellent	Excellent	Satisfactory	Excellent	Very Good
Ease of learning	(50)	Excellent	Very Good	Very Good	Satisfactory	Very Good	Very Good
Ease of use	(100)	Very Good	Very Good	Excellent	Good	Excellent	Good
Error handling	(50)	Very Good	Poor	Very Good	Poor	Very Good	Very Good
Support							
Support services	(25)	Very Good	Very Good	Very Good	Excellent	Very Good	Satisfactory
Technical support	(25)	Good	Satisfactory	Satisfactory	Very Good	Very Good	Satisfactory
Value	(100)	Excellent	Very Good	Excellent	Good	Excellent	Very Good
Final Scores		**8.6**	**6.6**	**7.9**	**6.0**	**8.5**	**6.7**

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CIRCLE 285 ON READER SERVICE CARD

many other computers in this review. It hosts a 128K memory cache that works in conjunction with the cache built into the 486 processor, and it accepts up to 8MB of RAM using 1MB SIMMs. A proprietary 32-bit slot can be used to add up to 16MB more. If you do not need the extra memory capacity, you can use the slot for standard 8-bit expansion cards instead. A higher-speed crystal can be substituted for the 8-MHz socketed crystal that comes with the unit to boost expansion bus speed—a worthwhile effort if your expansion cards are capable of operating at the higher clock rates.

The system's typical tower configuration provides room for as many as six half-height storage devices in a box that measures 25.5 by 9.3 by 18.5 inches. All bays are accessible through the front of the case, so any bay can be used for removable media storage. Our tested unit came with two floppy disk drives and a full-height hard disk, leaving two half-height bays open. The 230-watt power supply is not as large as some others found in similar cases, but it should be sufficient for all systems except those crammed full of drives and expansion cards.

The system was one of the few we tested in this roundup that carried an FCC Class B certification, which is evidence of its quality design and engineering. In fact, the only noticeable physical flaw in our tested system was the accompanying Chicony keyboard, which was dead on arrival, but that was a simple enough problem to correct.

How low can you go? With the Micro Express ME 486-25, $3,999—and that even includes 4MB of RAM. A 100MB hard disk, VGA monitor, and DOS 4.01 will up the ante to $5,570, but even this price is aggressively low. This system also obtained above-average benchmark test results and had fine documentation.

FACT FILE

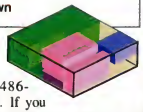
ME 486-25
Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; (800) 642-7621, (714) 852-1400.
List Price: With 4MB memory, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, one parallel and one serial port, $3,999; with 100MB hard disk, 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, VGA monitor, DOS 4.01, $5,570; with 150MB hard disk, 4.5MB caching disk controller, $7,197.
In Short: The ME 486-25 gives top-end 486 performance at one of the best prices around. Not only are the benchmark test results above average, but so is the documentation. The system would benefit from the inclusion of on-site service.

CIRCLE 428 ON READER SERVICE CARD

The documentation is not perfect, but it is far better than the typical low-cost-clone fare. In addition to the technical manuals from the component manufacturers, which are likely to be of interest to those with a fair amount of knowledge about computers, Micro Express produces its own well-illustrated system manual, which covers the fundamentals and even provides a glossary and index.

Micro Express's ME 486-25 two-year warranty would be more attractive if it were backed by on-site service, but the toll-free technical phone support and parts-swapping service should satisfy the needs of many users. When you take into consideration its many other merits, this is a system worthy of your attention if you want 486 power at an aggressive price.

MICRO TELESIS INC.
MT 486DX
by Bruce Brown



No one says you *have* to spend a lot of money on a 486-based computer. If you must use up budget dollars quickly, any of the companies whose machines are covered in this review will be happy to outfit you—at considerable cost—with multiple high-capacity drives, full memory complements, and magnificent video-adapter-and-display combinations, and throw in a $1,395 4167 math coprocessor chip just to top it all off. On the other hand, if you need the power of a 486 computer but want to keep the costs low—less than $5,000 for our standard configuration—Micro Telesis has an easily configurable machine that deserves your scrutiny.

The MT 486DX is a small-footprint model (measuring just 7 by 14.75 by 16.25 inches) with room inside for five drives and eight expansion cards. The $4,999 standard configuration is fully outfitted with 4MB RAM, an 85MB hard disk, a 5.25-inch floppy disk drive, a 16-bit Super VGA video display card and monitor, one parallel and two serial ports, a game port, a 101-key keyboard, and DOS, Version 3.3 or 4.01.

Our tested unit had a 160MB 28-millisecond Microscience hard disk, a DPT caching controller with 512K on-board, both 5.25- and 3.5-inch floppy disk drives, and an NEC MultiSync 3D monitor with 1,024 by 768 resolution. Even with all that, its list price was still only $6,299. While the hard disk is a little slow for the 486 class, the caching controller more than makes up the speed, as evidenced by the disk benchmark test scores.

The MT 486DX includes a motherboard made for Micro Telesis by M. A. Laboratories, with the 486 chip set support built into discrete logic and including the Phoenix ROM BIOS. The motherboard, like most others, has a socket for a Weitek chip, just in case you win the lottery. System and video ROM BIOS can be selected

A price leader, Micro Telesis's MT 486DX comes with a ticket of $4,999 for the standard configuration with a 100MB hard disk. Even in its small-footprint case, the system has room for eight expansion cards and five drives.

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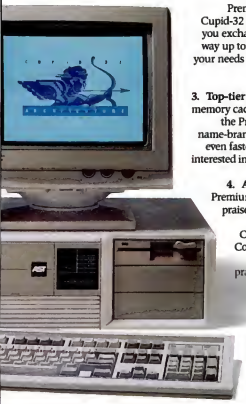

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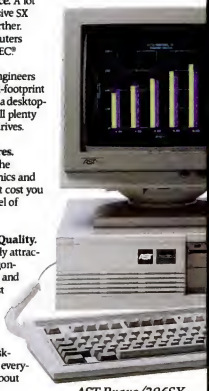

AST Bravo/386SX.
Starting at **$2095.**

*List prices are MSRP — 4/1/90. **Speed tests based upon Landmark Software version 1.10 benchmarks — a generalized index used to compare machines. The higher the number the better. ***Computer Reseller News, March 26, 1990. Source — Storeboard, Inc. AST markets products worldwide — Corporate Headquarters: P.O. Box 19658, Irvine, CA 92713-9658 (714) 727-9292, in Europe and the Middle East call 44 1 568 4350; in Japan call 81 3 818 0710; in the Far East call our Hong Kong office at 852 5 806 4333; in Canada call 416-826-7514; in Australia call 61 2 906 2200. AST is a supplier to U.S. government agencies, General Service Contract number GS00K89AGS6418. AST, AST logo and AST Premium registered and Cupid-32 and Cupid logo trademarks AST Research, Inc. All other product or brand names are trademarks or registered trademarks of their respective companies. Copyright 1990 AST Research, Inc. All rights reserved.

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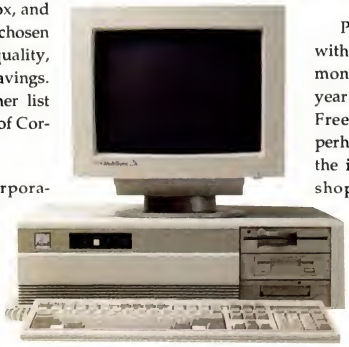

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PC Magazine Nov. 28, & Dec. 26 1989

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- 101 Keyboard
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PC LABS

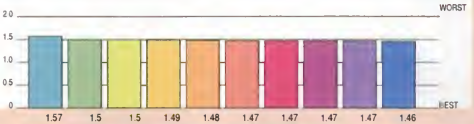
BENCHMARK TESTS: 25-MHZ 486-BASED PCs

The range in performance among all 24 486/25 PCs is so small that choosing one as a clear winner is an impossible task. Even though some vendors pack their machines with as much as 256K of external processor RAM cache, no system outshines any other in the processor and memory tests. Therefore, think twice about spending extra money on a computer whose only extra feature is the external RAM cache.

PROCESSOR AND MEMORY BENCHMARK TESTS

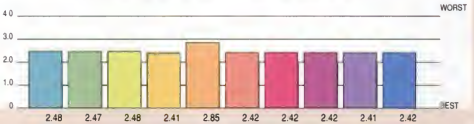
80386/80486 Instruction Mix

The **80386/80486 Instruction Mix** benchmark test times a series of tasks specific to the 80386 and 80486 chips.* Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.



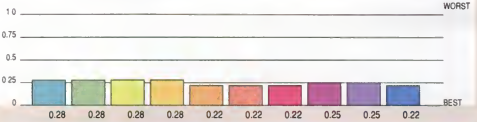
Floating-Point Calculation Without Coprocessor

The **Floating-Point Calculation Without Coprocessor** benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.



Conventional Memory

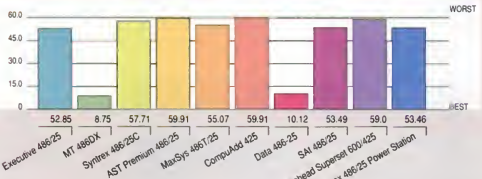
The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.



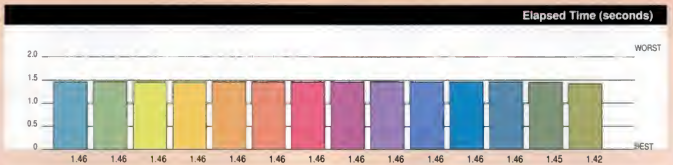
DISK BENCHMARK TESTS

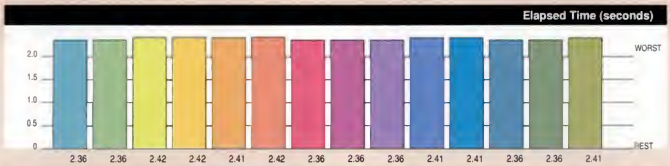
DOS File Access (Small Records)

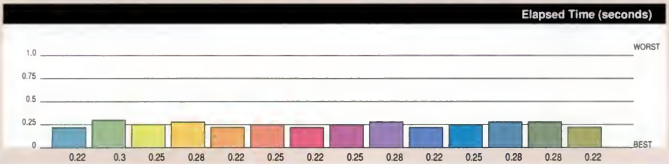
The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.

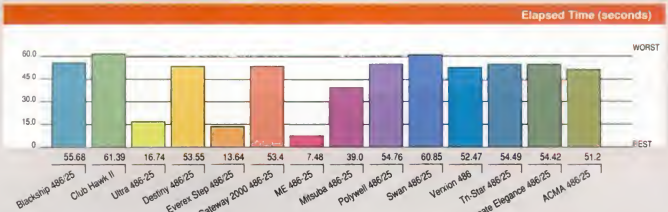


*Except for coprocessor and cache management, the 80486 instruction set is identical to the 80386.


Elapsed Time (seconds)
2.0
1.5
1.0
0.5
0
WORST
BEST
1.46 1.46 1.46 1.46 1.46 1.46 1.46 1.46 1.46 1.46 1.46 1.46 1.45 1.42


Elapsed Time (seconds)
2.0
1.5
1.0
0.5
0
WORST
BEST
2.36 2.36 2.42 2.42 2.41 2.42 2.36 2.36 2.36 2.41 2.41 2.36 2.36 2.41


Elapsed Time (seconds)
1.0
0.75
0.5
0.25
0
WORST
BEST
0.22 0.3 0.25 0.28 0.22 0.25 0.22 0.25 0.28 0.22 0.25 0.28 0.28 0.22


Elapsed Time (seconds)
60.0
45.0
30.0
15.0
0
WORST
BEST
55.68 61.39 16.74 53.55 13.64 53.4 7.48 39.0 54.76 60.85 52.47 54.49 54.42 51.2
Blackship 486/25
Club Hawk II
Ultra 486/25
Destiny 486/25
Everex Step 486/25
Gateway 2000 486/25
ME 486/25
Mitsuba 486/25
Polywell 486/25
Swan 486/25
Vanson 486
Tri-Star 486/25
Northgate Elegance 486/25
ACMA 486/25

CONTINUES

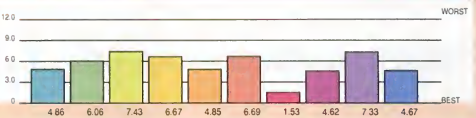
PC LABS

BENCHMARK TESTS: 25-MHZ 486-BASED PCs

DISK BENCHMARK TESTS

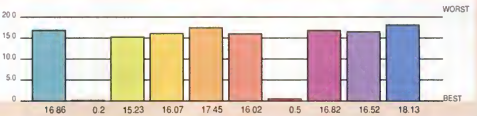
DOS File Access (Large Records)

The **DOS File Access (Large Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.



BIOS Disk Seek

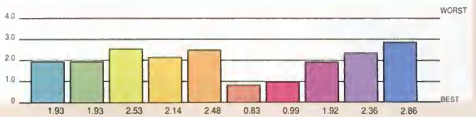
The **BIOS Disk Seek** benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.



VIDEO BENCHMARK TESTS

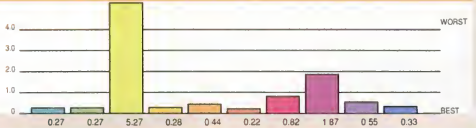
Direct to Screen

The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.



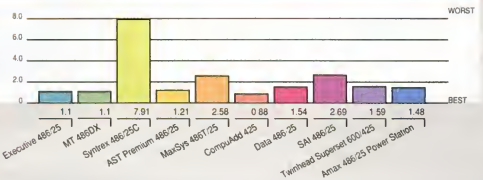
Video BIOS Routine Without Scrolling

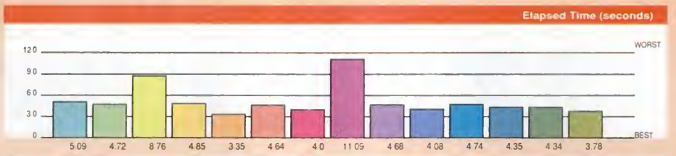
The **Video BIOS Routine Without Scrolling** benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.

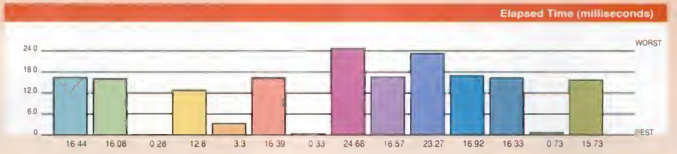


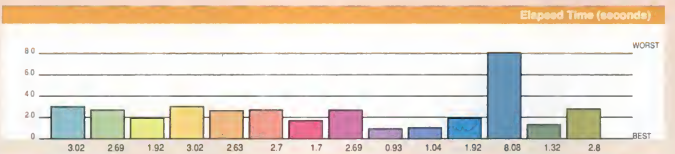
Video BIOS Routine with Scrolling

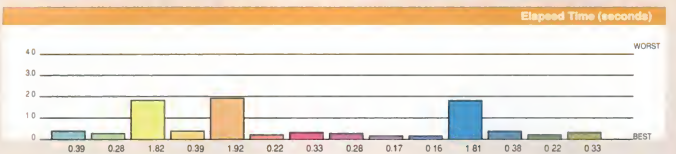
The **Video BIOS Routine with Scrolling** benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.

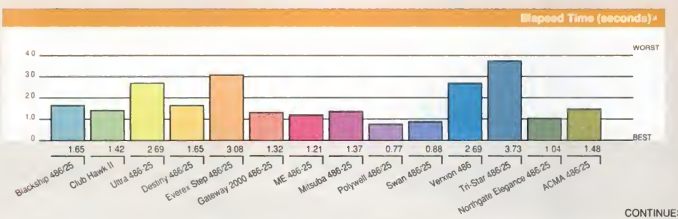



Elapsed Time (seconds)
12.0
9.0
6.0
3.0
0
WORST
BEST
5.09 4.72 8.76 4.85 3.35 4.64 4.0 11.09 4.68 4.08 4.74 4.35 4.34 3.78


Elapsed Time (milliseconds)
24.0
18.0
12.0
6.0
0
WORST
BEST
16.44 16.08 0.28 12.6 3.3 16.39 0.33 24.66 16.57 23.27 16.92 16.33 0.73 15.73


Elapsed Time (seconds)
8.0
6.0
4.0
2.0
0
WORST
BEST
3.02 2.69 1.92 3.02 2.63 2.7 1.7 2.69 0.93 1.04 1.92 8.08 1.32 2.8

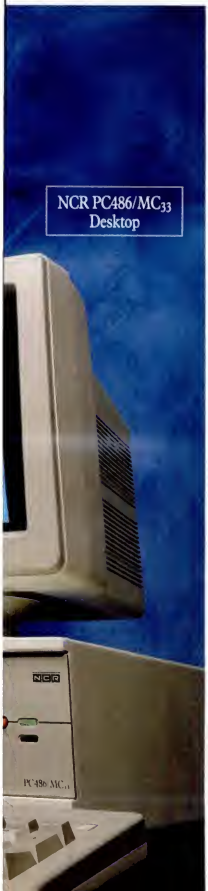

Elapsed Time (seconds)
4.0
3.0
2.0
1.0
0
WORST
BEST
0.39 0.28 1.82 0.39 1.92 0.22 0.33 0.28 0.17 0.16 1.81 0.38 0.22 0.33


Elapsed Time (seconds)[a]
4.0
3.0
2.0
1.0
0
WORST
BEST
1.65 1.42 2.69 1.65 3.08 1.32 1.21 1.37 0.77 0.88 2.69 3.73 1.04 1.48
Blackship 486/25
Club Hawk II
Ultra 486/25
Destiny 486/25
Everex Step 486/25
Gateway 2000 486/25
ME 486/25
Mitsubai 486/25
Polywell 486/25
Swan 486/25
Vernon 486
Tri-Star 486/25
Northgate Elegance 486/25
ACMA 486/25

CONTINUES

At 33MHz, They Out PC In The

perform Every Other World Today.



The Micro Channel™ Architecture NCR PC486/MC33 and S486/MC33. They're hot, and they're available.

"With the PC486/MC33, NCR has introduced innovations in technology that will drive the market to still higher levels of performance...NCR is well on the way to accomplishing its goal of leading the pack in this technology." –PERSONAL WORKSTATION, *June 1990.*

"NCR PC486/MC33 Shows Most Consistent Overall Speed Advantage." –PC WEEK, *June 4, 1990.*

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According to industry benchmarks, our systems deliver a staggering 27MIPS. That's 32% faster than most 25MHz i486™-based PCs. Our systems come in either a small footprint desktop or highly expandable, floor-standing server configuration.

And they're available *now.*

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- 33MHz i 486 Microprocessor
- Micro Channel Architecture
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- High-Speed, Intelligent SCSI Coprocessor
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- Available Now

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The Strategy For Managing Change.

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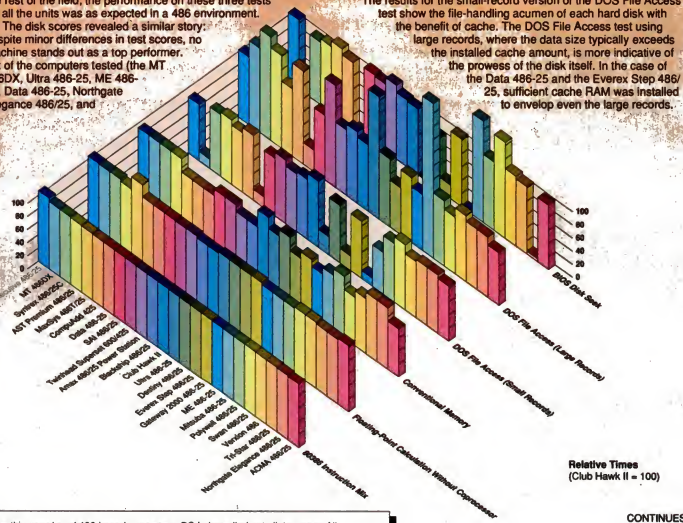
PC LABS PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW

Despite the minor differences among the scores on our processor and memory tests, we found a great equality among the workings of the motherboard electronics for all the reviewed machines. These tests were performed with system BIOS shadowing turned on, so the numbers you see represent the most rapid rate of activity possible for each computer. No single unit distinguished itself from the rest of the field; the performance on these three tests for all the units was as expected in a 486 environment.

The disk scores revealed a similar story: despite minor differences in test scores, no machine stands out as a top performer. Six of the computers tested (the MT 486DX, Ultra 486-25, ME 486-25, Data 486-25, Northgate Elegance 486/25, and Everex Step 486/25) show extremely low BIOS Disk Seek scores. These numbers are invalid, however: in all cases but the Northgate, the drives were coupled to caching hard disk controllers. The Northgate Elegance 486/25 lacks a caching disk controller, but the system's Maxtor hard disk uses proprietary electronic enhancements to improve data throughput.

The results for the small-record version of the DOS File Access test show the file-handling acumen of each hard disk with the benefit of cache. The DOS File Access test using large records, where the data size typically exceeds the installed cache amount, is more indicative of the prowess of the disk itself. In the case of the Data 486-25 and the Everex Step 486/25, sufficient cache RAM was installed to envelop even the large records.



For this roundup of 486-based computers, PC Labs pulled out all the stops. All machines were tested with processor RAM cache enabled and full system and video BIOS shadowing turned on (except for the Northgate Elegance 486/25, which does not implement shadowing). For the hard disk tests, no BUFFERS statement was used in the CONFIG.SYS file; instead, the DOS default of 15 buffers was left in place. For every machine using a caching disk controller, all controller drivers were enabled if they were originally included on the system when it was received from the vendor.

CONTINUES

or turned off independently via the ROM-based setup program.

The machine can accommodate up to 16MB of RAM on a single 32-bit memory card. The RAM arrangement is interleaved page-mode memory using 80-nanosecond 1MB SIMMs.

The 8-MHz expansion bus has two 8-bit and five 16-bit slots in addition to the 32-bit proprietary memory board slot. In our tested machine, the included memory, video, drive controller, and I/O cards left four slots free.

The system leaves ample space for installation of up to three half-height and two 3.5-inch-format storage devices (there was still room in the tested unit for an additional hard disk and an internal tape drive), and the 200-watt power supply with four storage-device power leads is appropriate for a machine of this type.

Micro Telesis sells computers directly by mail order and to dealers (with discounts available), but there is no specific dealer channel or dealer authorization program. You'll have to deal directly with Micro Telesis for service, unless you make other arrangements with a local dealer or service provider.

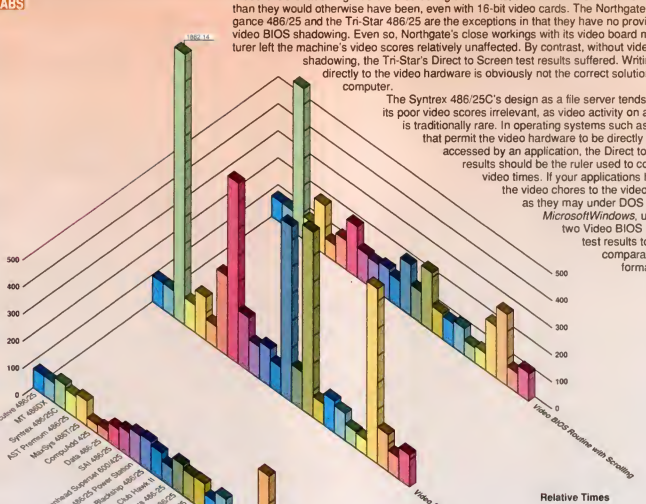
Parts and labor are both covered for 13 months, which is probably an insignificant increase over the normal one-year coverage. There is no standard on-site service contract, but Micro Telesis will provide re-

VIDEO BENCHMARK TESTS: COMPOSITE VIEW

PC LABS

Video BIOS shadowing was enabled during these tests, and the results are uniformly faster than they would otherwise have been, even with 16-bit video cards. The Northgate Elegance 486/25 and the Tri-Star 486/25 are the exceptions in that they have no provision for video BIOS shadowing. Even so, Northgate's close workings with its video board manufacturer left the machine's video scores relatively unaffected. By contrast, without video shadowing, the Tri-Star's Direct to Screen test results suffered. Writing directly to the video hardware is obviously not the correct solution for this computer.

The Syntrex 486/25C's design as a file server tends to make its poor video scores irrelevant, as video activity on a server is traditionally rare. In operating systems such as DOS that permit the video hardware to be directly accessed by an application, the Direct to Screen results should be the ruler used to compare video times. If your applications hand off the video chores to the video BIOS, as they may under DOS and *MicrosoftWindows*, use the two Video BIOS Routine test results to gauge comparative performances.



ENDS

PC MAGAZINE FACT FILE

MT 486DX
Micro Telesis Inc., 1260 Logan Ave., # A-2, Costa Mesa, CA 92626; (714) 557-2003.
List Price: With 4MB RAM, 85MB hard disk, 1.2MB 5.25-inch floppy disk drive, super VGA monitor, one parallel and two serial ports, game port, DOS 3.3 or 4.01, $4,449; with 100MB hard disk, $4,999; with 160MB hard disk, DPT cache controller, 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, $6,299.
In Short: A top-notch small-footprint system.

CIRCLE **429** ON READER SERVICE CARD

placements for defective parts via next-day UPS shipping. The company offers a 48-hour turnaround time for machines that are sent in for service; here, Micro Telesis pays shipping costs and returns the unit to you using the same method you used in sending it.

The MT 486DX computer offers the advantages of a very reasonable price, quality performance, and a small size that appears to be as expandable as a standard desktop unit. If you're looking for a good deal in a 486 PC, you may not have to look any further.

MITSUBA CORP.

Mitsuba 486-25

by M. David Stone

Built around a Micronics motherboard in a desktop chassis, the Mitsuba 486-25 is pretty much what you would expect: a unit that isn't very different from any number of other plain-vanilla 486 computers. It is,

the Dustin Report

LASER PRINTER FONT CARTRIDGES

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Super Set + 425 in One

ANALYSIS:
If typographic flexibility and quality is important to your PC applications, then this versatile product from Computer Peripherals, is just what you need for your HP LaserJet series printer. SuperSet+ has combined 425 fonts in one single cartridge, and includes all the fonts you'll find in HP's *"ProCollection"*, Pacific Data's *25 in One!"* and HP's *"Microsoft"* font cartridges combined, and is rounded out with special Math, Linedraw, Dingbats and Lotica fonts. You will also find JetWare's exclusive 12/30 spreadsheet fonts, which allow you to print up to 40,000 characters on a standard page.

SuperSet+ delivers genuine licensed LinoType * Helvetica and Times fonts in point sizes from 6 to 18 point, and most fonts come with a full complement of 7 symbol sets. Courier is available with 7 European symbol sets: French, German, Italian, Danish, Spanish, Swedish, and UK for international correspondence.

Eleven software print drivers support all the most popular application packages and address all of the fonts, point sizes and symbol sets currently in use.

SPECIFICATIONS:

Software compatibility:
WordPerfect, MS Word 5.0, MS Windows including *Excel 2.0, PageMaker, Word,* and *Am'i Professional; Ventura Publisher 2.0; WordStar 5.5 & 5.0; Lotus 1,2,3-3.0 & 2.0.*

Printer Compatibility:
HP LaserJet Series II, IID, IIP, III, and *PCL* compatible printers, such as the *Canon LBP-811.*

Warranty:
JetWare's standard Five Year Limited Warranty

Interfaces:
Parallel, Serial, Both (two computer support) and the optional I/O slot.

Paper Sizes:
Letter, Legal, Executive, European A4 & B5

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At $8,695 for the standard configuration, the Mitsuba 486-25 approaches the high end of the price spectrum, with very few outstanding extras. Because the system is distributed through dealers, however, discounts are frequently available.

however, somewhat more pricey than many of those other boxes.

Our standard configuration is priced at $8,525 with 4MB RAM, a 108MB hard disk, 64K of 25-nanosecond cache, a 5.25-inch floppy disk drive, one parallel and two serial ports, a game port, and Mitsuba's own video card and VGA monitor. The card offers VGA, Super VGA, and noninterlaced 8514/A modes, which is more than our standard configuration demands. The tested configuration, at $8,695, substituted a multifrequency Super VGA monitor with a maximum resolution of 800 by 600 pixels. All prices include a one-year warranty, on a return-to-dealer basis.

The reset switch, turbo switch, turbo indicator, and keyboard lock are all on the front panel of the chassis. Inside, you'll find the usual five half-height drive bays, arranged as three plus two. Two bays in the reviewed unit were used for the full-height hard disk, and a third bay was used for the floppy disk, leaving two bays available for expansion.

Also inside the box is the Micronics motherboard complete with the 486-25 chip, a combination of discrete logic plus one chip from the Chips and Technologies chip set, and a socket for a Weitek 4167. The reviewed system did not include the Weitek chip, which can add several thousand dollars to the price.

Like some other systems reviewed here that use the Micronics motherboard, the Mitsuba 486-25 came with a 386 version of the Phoenix BIOS. Mitsuba says that if you get the 386 BIOS, the 486 version will be a free upgrade—but you will have to arrange the upgrade through your dealer.

The Mitsuba 486-25 ships with a minimum of 64K external static RAM cache on the motherboard, which also has the discrete logic to serve as a cache controller. Although the cache can be upgraded to 128K or 256K, there seems no reason to bother, since PC Labs' processor and memory tests show little difference among systems, regardless of how much cache is installed.

Elsewhere on the motherboard are eight 16-bit slots, and 16 SIMM sockets that allow a system maximum of 16MB of RAM. On the reviewed unit, four of the sockets were filled with 1MB SIMMs using 80-nanosecond chips. The SIMM sockets are conveniently located between the system slots and the power supply.

Three expansion slots were filled—with a Data Tech Corp. disk controller, the Mitsuba CVGA-512 video card, and a parallel/serial card. A fourth slot was blocked by the game port and second serial port, which attach to the parallel/serial card by ribbon cable. This is an unnecessary waste of a slot, since there are additional cutouts on the back panel. If you get this system, be sure to insist that any extra connectors take advantage of the cutouts.

Performance on PC Labs' tests ranged from average or better on processor, memory, and video tests to well below average for the disk tests. The poor disk performance is a direct result of the 25-millisecond hard disk that Mitsuba provided for the reviewed unit; it is simply the wrong choice for this class of machine. Fortunately, Mitsuba offers several other disk options. You can also buy the system without a hard disk and install one of your own choice.

Overall, the Mitsuba 486-25 rates a lukewarm recommendation, primarily because of the price. It's simply too easy to find other desktop systems—such as Dataworld's Data 486-25—that offer the same or better performance with many of the same components at a lower cost. Yet there are no fatal flaws, and keep in mind that the system is sold through dealers, so that its street price is likely to be lower than the list price. If you find it at a sufficient discount and with a faster hard disk, don't rule it out.

PC MAGAZINE FACT FILE

Mitsuba 486-25
Mitsuba Corp., 650 Terrace Dr., San Dimas, CA 91773; (800) 648-7822, (714) 592-2866.
List Price: With 1MB RAM, 1.2MB 5.25-inch floppy disk drive, Hercules-compatible display, one parallel port, $6,175; with 4MB RAM, 108MB hard disk, VGA monitor, one parallel and two serial ports, game port, DOS 3.3, $8,525; with super VGA monitor, $8,695.
In Short: The Mitsuba 486-25 is so convincingly plain-vanilla typical that any recommendation depends entirely on cost. There are no fatal flaws but also nothing to make it stand out from the pack. At list price it's too expensive, but with the typical dealer's discount it may be worth considering.

CIRCLE 542 ON READER SERVICE CARD

NORTHGATE COMPUTER SYSTEMS INC.

Northgate Elegance 486/25

by Bill O'Brien

The Northgate Elegance 486/25 is not just another pretty tower with a hodgepodge of miscellaneous electronic and mechanical components tossed inside. Even the $5,830 base-priced machine, which coincides with our standard configuration, is a functional tool, complete with all of the performance goodies needed to exemplify 486 levels of computing.

Strip away the case and you'll find that the platform for the Elegance 486/25 is a motherboard from The Motherboard Factory. But Northgate isn't just another buyer of mass-produced boards from a third-party vendor. Northgate owns The Motherboard Factory.

Northgate has chosen to include 64K of cache with the basic configuration. Rated at 20 nanoseconds, it feeds the 4MB of 80-ns. system RAM at a rapid pace. As with all of the computers reviewed, there is no single cache controller used to manage the rapid data transit. But uncharacteristically for the computers in this review, no specific 486 chip set is used in this version of the Elegance. The task of managing the system falls to an array of discrete components, and while that does run against the grain of other motherboard philosophies,

Northgate claims a simpler and cheaper repair regimen with this arrangement should something ever go awry.

Following in a long-standing Northgate tradition, the Elegance 486/25 also ignores the potential benefits of BIOS shadowing. There is no attempt to relocate either the system or video BIOS into faster RAM areas from their relatively slow ROM origin. But apparently the company has discovered some secret formula, because the benchmark test scores indicate no performance loss from this departure from motherboard design convention. Northgate has also managed to negate any of the potential problems caused by reserved memory areas used to house relocated BIOS instructions.

Usable in both the home and the office, thanks to its FCC Class B rating, the Northgate Elegance 486/25 scores points for its excellent performance and functional base-priced system. The $5,830 price includes a 200MB hard disk.

We must mention the Maxtor hard disk shipped as standard equipment with the Elegance 486/25. While it does carry the Maxtor label, Northgate claims that it is a proprietary drive and officially labeled the PowerMax-200. Normally the basic LXT-200 IDE disk is a relatively fast unit, but whatever Northgate has done to it, the performance of this version is even better. PC Labs' disk benchmark tests indicate that its large-record DOS File Access performance is similar to that of many disks using high-capacity caching. The small-record score is average, reflecting the head latency (the mechanical penalty corresponding to the time it takes the read/write head to reach and settle at its specified track and sector), but the performance is phenomenal for a noncaching system.

The keyboard and video system are also crucial in computing, and here too Northgate has done quite well. The Headland Technology Super VGA card teamed with an NEC MultiSync 3D monitor is a winning combination. The MultiSync costs $650 more than the monochrome VGA monitor that comes as standard equipment,

FACT FILE
EDITOR'S CHOICE

Northgate Elegance 486/25
Northgate Computer Systems Inc., Northgate Park, Eden Prairie, MN 55344; (800) 548-1993.
List Price: With 4MB RAM, 64K processor RAM cache, 200MB hard disk, 1.2MB 5.25-inch floppy disk drive, monochrome VGA monitor, one parallel and two serial ports, DOS 4.01, *Microsoft Windows* 3.0, $5,830; with 256K processor RAM cache, color VGA monitor, $7,345.
In Short: The Northgate Elegance 486/25 gets high marks for its Class B–rated tower, outstanding performance, and functional base system at an affordable price.

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but it is well worth the bump in price.

Northgate's keyboards are nearly legendary, although almost too prolific for us to keep track of the various models and features. The current version, called the Omnikey Ultra, contains 119 keys. It has 12 extra function keys situated across the top of the keyboard (in addition to the usual twelve function keys placed along the left side). There are also a period/comma lock key and several other idiosyncracies.

Our only complaint with the Elegance 486/25 is the similar appearance and close proximity of the turbo and reset buttons. Fortunately, it's difficult to imagine any reason for putting a 486 computer into 8-MHz compatibility mode, which is the only time you might accidentally hit the reset button.

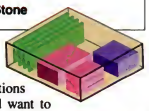
A big plus is the machine's FCC Class B rating, even in its tower configuration. With its relatively low price and high performance, the Northgate Elegance 486 will be equally at ease in the home or office and is highly recommended.

In its attractively narrow desktop case, the $7,000 Executive 486/25 has a passive-backplane design that will make future upgrades simple and inexpensive. Osicom Technoiogies' unique design appeals to the buyer who thinks ahead, but its lack of math coprocessor support makes it the wrong choice for CAD functions.

OSICOM TECHNOLOGIES INC.

Executive 486/25

by M. David Stone



If you are looking beyond the current configurations of the 486 and want to run your computer at even faster speeds than the 25 MHz possible now, the Executive 486/25—formerly called the MORE 486/25—could be the machine for you. While Osicom Technologies' entry looks and performs like any other desktop 486 computer, you'll find a relatively uncommon passive-backplane design and some interesting possibilities for upgrades with a simple change of the 80486 chip and clock crystal.

PC Magazine's standard configuration for the Executive 486/25 lists for $7,000 and includes 4MB RAM, a 100MB hard disk, one 5.25-inch floppy disk drive, a VGA card and monitor, and one parallel and two serial ports. The system that Osicom provided for review, packed with a Seagate 151MB 16-millisecond hard disk and a Paradise 1024 video card with 512K of memory, costs $7,250. All prices include one year of on-site support through Dow Jones Service.

The Executive 486/25 chassis measures 19.5 inches wide, slightly narrower than a standard-size AT system. In most other ways, the unit follows typical desktop design, with the power switch on the right side and the reset button and keyboard lock on the front panel. Other typical desktop features include the five half-height drive bays in stacks of three plus two. On the reviewed unit, a full-height hard disk filled two bays and a floppy disk drive occupied another, leaving two bays available for expansion.

Inside the box, the passive backplane contains no other features besides the keyboard connector, six 16-bit expansion slots, and two 8-bit slots. Because of the narrow case, three of the slots, including two 16-bit slots, sit in line with the disk drives, where they can accommodate only half-length cards.

The processor board fits in one of the full-length 16-bit slots. On the board you'll find the 80486 chip, a Headlands Technology chip set, Osicom BIOS, and all system RAM. The reviewed unit included four 1MB SIMMs using 80-nanosecond chips. Four additional SIMM sockets allow a maximum of 8MB on the board itself. If you need more RAM, an optional add-on memory card will hold 16MB, for a total system memory of 24MB. The memory card was not in production at review time, but according to Osicom, it should be available by the fourth quarter of 1990.

Notably absent from the processor board is any external cache or a socket for a Weitek 4167. Admittedly, our test results indicate that the lack of an external cache won't have much effect when the unit is running under DOS. But the missing 4167 support makes the Executive 486/25 the wrong choice if you need heavy-duty number-crunching abilities, at a CAD workstation, for example. With most applications this won't be an issue.

The review system came with three other slots filled: one with a Western Digital ESDI disk controller, one with a parallel/serial board, and one with the Western Digital Paradise 1024 card. This card supports VGA, Super VGA, and 8514A interlaced video. The system we tested included a VGA monitor, built by Samtron and sold as the Osicom VGA.

Upgradability is one of the advantages of this machine. The processor board's design allows you to upgrade to a faster system simply by changing the 80486 chip and the clock crystal. According to Osicom, the unit can handle system speeds up to at least 50 MHz. The next version of the board, which should be available by the end of 1990, will permit upgrades to even faster speeds. Osicom expects to let users move up to the later-generation board, though it has yet to determine the upgrade policy. Since it currently provides a 486 upgrade for its 386 systems, it already has a track record in this area.

On PC Labs' tests, the Executive 486/25's scores were average overall. On the memory and processor tests, the scores slid toward the bottom of the heap, but the results for all the machines fell so close to-

PC MAGAZINE FACT FILE

Executive 486/25
Osicom Technologies Inc., 198 Green Pond Rd., Rockaway, NJ 07866; (800) 922-0881, (201) 586-2550.
List Price: With 1MB RAM, 1.2MB 5.25-inch floppy disk drive, one parallel and two serial ports, DOS 3.3, $4,799; with 4MB RAM, 100MB hard disk, VGA monitor, $7,000; with 151MB hard disk, upgraded 8415 A-compatible video card, $7,250.
In Short: Slightly narrower than most desktop systems, the Executive 486/25 offers a passive-backplane design and upgradability. The lack of 4167 support makes this the wrong system for CAD or other heavy-duty number-crunching applications.

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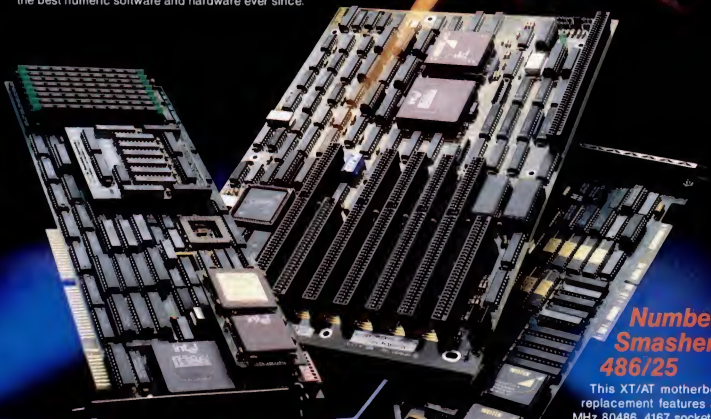

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	486	4167
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Megawhetscales	4.1	9.9

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gether that the differences hardly matter. On the disk and video tests, it scored average or better.

All told, the Executive 486/25 seems a credible system, made more attractive by its upgradability. Other computers that list for less money can equal or better its performance, but the savings when upgrading may well offset the slightly higher immediate cost. Since Osicom sells through dealers only, the system should be available at a discount. Even if you have no interest in the upgrade possibilities, you won't be unhappy with the system if you can find a substantial discount.

PC CONNECTIONS/ DESTINY COMPUTERS INC.

Destiny 486/25

by Alfred Poor

At a list price of $8,945 for a standard configuration that includes 4MB of RAM, a 100MB hard disk, and a color VGA monitor, the Destiny 486/25 seems at first to be a rather expensive machine. Luckily, the company makes its systems available only through dealers and resellers, so you may find them discounted to the tune of a couple of thousand dollars, resulting in a figure more competitive with direct marketing prices.

Our evaluation unit (with a list price of $9,500) came in a case bigger than a minitower yet smaller than a standard tower; it's about the size and shape of an AT case standing on its side. Inside, there is room to accommodate almost the same number of storage components as a standard tower configuration: six half-height devices, four of which are accessible through the front of the case. The system also provides a typical number of 16-bit expansion slots for a tower unit—eight of them.

On the front panel, you'll find the usual complement of power, speed, and reset switches, with the addition of a plastic dust cover that can slide over them. This can be a handy safety feature if you decide to use the machine as a network file server, preventing the inquisitive or accidental poke at a reset button that can have disastrous consequences!

The motherboard by Advanced Integration Research (AIR), an initially unknown quantity, became quite familiar to us during the course of this review; it was being used in a fair number of the 486s we tested. The 4MB of SIMM RAM on the motherboard is ample for many applications used today, but you may well need more in the future. The AIR motherboard design has this pretty well covered: it is able to fit a full 16MB of 32-bit memory, which is just fine for the immediately predictable needs of DOS users.

One of the system's expansion slots contained a VGA adapter card from Orchid—a ProDesigner board capable of 1,024 by 768 resolution. The ADI color monitor that came with our system can handle 1,024 by 768 interlaced signals for high-resolution images. Accompanying driver/utility disks from Orchid will let you take advantage of these capabilities with *AutoCAD, Microsoft Windows* (Versions 1.04, 2.00, and 386 2.01), *Ventura Publisher, Lotus 1-2-3,* and *WordPerfect* 5.0.

The hard disk in our test unit was a Maxstor ESDI model with a formatted capacity of almost 160MB, driven by a floppy/hard disk controller from NCL America. While this controller is not as well known as some others, such as those from Western Digital, it seemed to function handily enough. The benchmark test scores for all the machines in this review generally fell within a tight range, and the Destiny 486/25 chalked up acceptable average scores on our disk tests, as well as on the others in the suite.

While the $8,945 standard configuration of PC Connections/Destiny Computers' Destiny 486/25 includes 4MB of RAM, a 100MB Maxstor hard disk, and a color VGA monitor, the system is missing a few essentials, such as I/O ports and thorough documentation.

FACT FILE

Destiny 486/25
PC Connections/Destiny Computers Inc., 754 Whitney St., San Leandro, CA 94577; (800)366-4272.
List Price: With 1MB memory, 40MB hard disk, 1.2MB 5.25-inch floppy disk drive, Hercules-compatible monitor, one parallel and two serial ports, $7,294; with 4MB RAM, 100MB hard disk, VGA monitor, DOS 4.01, $8,945; with 150MB hard disk, super VGA monitor, $9,500.
In Short: The Destiny 486/25 is a mix of generic parts and brand-name components. It is well designed and built, and performs on a par with the rest of the pack. Its list price is high, but discounts could bring the price down to a competitive level.

CIRCLE **545** ON READER SERVICE CARD

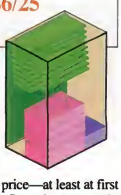
Perhaps the most surprising aspect of the tested machine is that it came configured without any I/O ports. While it is simple enough to add an inexpensive I/O card on your own, it seems strange that a machine at this level would not include one as a standard feature. The documentation also is considerably less ample than one might expect, consisting mainly of a loose packet of pamphlets from the component vendors.

The Destiny 486/25 stacks up as a middle-of-the-road performer that uses some top-brand components but relies on other less familiar items in key areas. You should consider this system if you find it available from a local dealer or value-added reseller who offers some additional advantages (such as special software or support), but it is not so exceptional that you should launch an all-out search to find your Destiny.

POLYWELL COMPUTERS INC.

Polywell 486/25

by Alfred Poor



At $6,150 for our standard configuration, including 4MB of RAM, a 100MB hard disk, and a super VGA monitor, the Polywell 486/25 certainly seems ready to compete on price—at least at first glance. Although that figure is more costly than some comparable systems reviewed

here, the machine is distinguished by some signs of extra effort, like a second cooling fan mounted at the front of the expansion card cage to increase air circulation and reduce heat.

Polywell offers a wide range of options so you can custom-tailor your system. For example, you can pick from three different VGA adapters and seven different monitors.

The $7,250 unit we tested was assembled from increasingly familiar components, such as the Ultrastor disk controller with a 32K on-board buffer and a motherboard from Advanced Integration Research (a choice echoed in many of the other machines reviewed here). This motherboard can carry a whopping 16MB of system memory using 1MB SIMMs, which means there's no current need for a memory expansion card.

The tested system also came with some standard favorites, like a Seagate/CDC Wren III 155MB hard disk, TEAC floppy disk drives and an Orchid ProDesigner video adapter. The CTX monitor is less well known but worked just fine.

All of the components mentioned above were mounted in (or attached to) an unusual minitower case—15.7 by 8.6 by 19.7 inches—about the size of a thick desktop AT positioned on its side. Five half-height disk bays are all accessible through the front. There is a swinging door that covers the front panel and opens to expose the disk drives.

This thin plastic door doesn't provide any security protection (or added convenience); in fact, one hinge tab broke off and it no longer stayed in place reliably. That should not be taken as an indication of the general system construction, though; the rest of the case and the chassis were sturdy.

At $6,150 for our standard configuration, Polywell Computers' Polywell 486/25 is a middle-of-the-road value. Above-average warranty and service policies help differentiate this computer from other name-brand-component systems.

FACT FILE

Polywell 486/25
Polywell Computers Inc., 61-C Airport Blvd., South San Francisco, CA 94080; (800) 999-1278, (415) 583-7222.
List Price: With 1MB RAM, 1.2MB 5.25-inch floppy disk drive, one parallel and two serial ports, game port, $3,975; with 4MB RAM, 128K processor RAM cache, 100MB hard disk, 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, super VGA monitor, DOS 3.3 or 4.01, $6,150; with 8MB RAM, 155MB hard disk, caching disk controller, $7,250.
In Short: The Polywell 486/25 is a middle-of-the-road value, assembled from good components but failing to excel in either price or performance. We found some nice touches, marred only by skimpy documentation and a broken hinge tab on the disk drive door.

CIRCLE 546 ON READER SERVICE CARD

The system also gets points for going one step beyond hosting a simple turbo indicator light, instead providing a digital display showing the CPU's operating speed.

On PC Labs' benchmark tests, the system's numbers tended to be about average for the class as a whole, although the disk performance times were a bit below average. The machine did stand out on the video benchmark tests, but that is as much a measure of the Orchid adapter as anything else.

The documentation is thin, as is typical with low-cost systems. The bulk of it consists of fairly technical listings provided by the manufacturers of the various components. Polywell does produce some original documentation material, but the 486/25 version was not available in time for this review. If the upcoming 486 manual resembles the 386-based information that was provided, you should not expect it to be very helpful. If you need help from the company, you'll find it in the form of a one-year warranty on parts (longer on the motherboard, VGA card, and monitor) and five years on labor. Polywell also provides optional on-site service via RTIN.

While it has some nice touches, overall the Polywell lacks the high performance or bottom-line low price (except perhaps in its $3,975 basic configuration, with 1MB RAM and no hard disk or monitor) that would make it more than a middle-of-the-road value.

SAI SYSTEMS LABORATORIES INC.

SAI 486/25

by Edward Mendelson

If you're in the market for a really inexpensive 486, you may want to consider SAI Systems Laboratories, which offers our standard configuration for $4,495 and sells a stripped-down 486/25 for a low $3,595. The latter version is missing the 40MB hard disk, but it does include a good deal: 4MB of RAM, 64K of CPU RAM cache, a 5.25-inch floppy disk drive, one parallel and two serial ports, a Focus 2001 keyboard, DOS, and a Logitech mouse. And if your budget won't allow you to spring for a word processor, you may appreciate the *WordStar* clone that is also included in the price.

The considerably better-equipped SAI 486/25 we tested (a $5,495 configuration) performed about equal to most other machines in its class—which is not so surprising if you consider that, like many 486s currently available, it consists mostly of standard parts from reliable manufacturers. In fact, some of the internal components seem like old friends of PC Labs. The tested unit came with a full-height 150MB Imprimis ESDI hard disk and Ultrastor disk controller, two items that deserve their familiarity because they're

A solid performer with name-brand components, the SAI 486/25 from SAI Systems Laboratories contains no unwelcome surprises. Its price of $5,495 is on the low side of the average among all machines tested.

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THE HIRSCH REPORT OF THE SKIES VOL. 9, NO. 4, FALL 1990

STAR SHORTS

Reported by The Star

Every day billions of dust particles enter into Earth's atmosphere. Now scientists are working to make meteor-burst communication a practical and economical alternative to the use of tele-

(continued on page 2)

You Can't See the Great Wall from the Moon!

Everyone has heard that you can see the Great Wall of China from the Moon. Or from Earth orbit. Or even from Mars. Certainly you cannot see the Great Wall from the Moon. According to an astronaut, it's difficult even seeing continents. You may be able to see the Great Wall from orbit, but, in general, it's difficult even to see familiar objects; the planet's swift mo-

(continued on page 3)

Voyager's Last Picture Show:
When Voyager 2 was launched 12 years ago, who could have imagined these photos at this point in time.

More on planetary explosions inside.

NO BLACK HOLES?

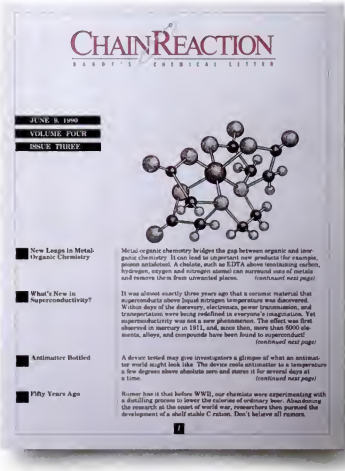
Scientists are still unable to confirm the existence of even a single black hole, despite widespread belief that such things should exist. Tracking down these invisible objects isn't easy, because they can only be studied indirectly by the effects they have on their surroundings. There are several types of places that

(continued on page 3)

MIRROR, MIRROR

It's a chore, but all reflecting telescopes require cleaning their reflective mirrors. Eventually, the aluminum coating on their mirrors deteriorates and needs replacing. For large instruments, the process requires removing the tele-

(continued on page 5)



CHAIN REACTION

BAGDIT'S CHEMICAL LETTER

JUNE 9, 1990

VOLUME FOUR

ISSUE THREE

New Loops in Metal-Organic Chemistry

Metal organic chemistry bridges the gap between organic and inorganic chemistry. It can lead to important new products (for example, poison antidotes). A chelate, such as EDTA above tantalizing carbon, hydrogen, oxygen and nitrogen atoms) can surround ions of metals and remove them from unwanted places. *(continued next page)*

What's New in Superconductivity?

It was almost exactly three years ago that a ceramic material that superconducts above liquid nitrogen temperature was discovered. Within days of the discovery, electronics, power transmission, and transportation were being redefined in everyone's imagination. Yet superconductivity was not a new phenomenon. The effect was first observed in mercury in 1911, and, since then, more than 6000 elements, alloys, and compounds have been found to superconduct! *(continued next page)*

Antimatter Bottled

A device tested may give investigators a glimpse of what an antimatter world might look like. The device cools antimatter to a temperature a few degrees above absolute zero and stores it for several days at a time. *(continued next page)*

Fifty Years Ago

Rumor has it that before WWII, our chemists were experimenting with a distilling process to lower the calories of ordinary beer. Abandoning the research at the onset of world war, researchers then pursued the development of a shelf stable C ration. Don't believe all rumors.

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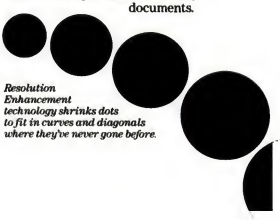

Resolution Enhancement technology shrinks dots to fit in curves and diagonals where they've never gone before.

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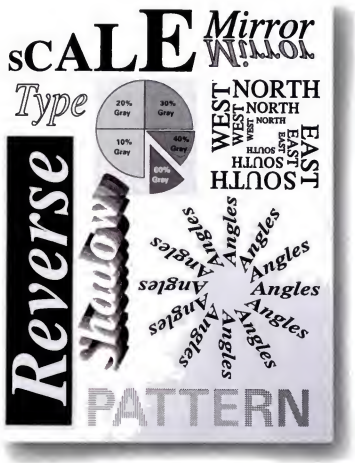
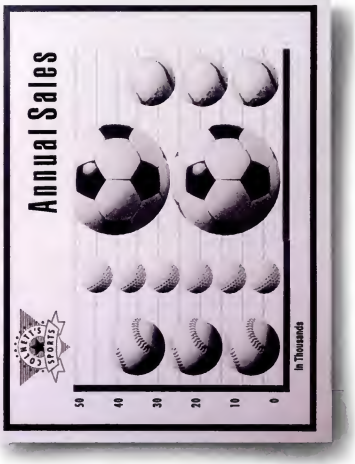
whole new ball game.





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HEWLETT PACKARD

*Suggested U.S. list price. WordStar is a U.S. registered trademark of WordStar International Incorporated. Adobe and PostScript are registered trademarks of Adobe Systems, Inc.

FACT FILE

SAI 486/25
SAI Systems Laboratories Inc., 911 Bridgeport Ave., Sheldon, CT 06484; (203) 929-0790.
List Price: With 4MB RAM, 128K processor RAM cache, 1.2MB 5.25-inch floppy disk drive, Hercules-compatible monitor, one parallel and two serial ports, DOS 3.3 or 4.01, mouse, $3,595; with 100MB hard disk, VGA monitor, $4,495; with 150MB hard disk, 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, Paradise VGA card and NEC MultiSync 3D monitor, $5,495.
In Short: SAI's desktop 486 is a solid basic machine at an ultracompetitive price, stocked with familiar high-quality parts in a generic case. The tested unit contained 128K of processor RAM cache, but SAI will have a new motherboard with a hefty 256K of cache by the time you read this.

CIRCLE 547 ON READER SERVICE CARD

among the best you can buy. (You can choose among disks ranging from 40MB to 600MB.) The machine also included 128K of processor RAM cache, two TEAC floppy disk drives, a Paradise VGA card (which performed rather slowly in our Video BIOS Routine with Scrolling test), and the excellent NEC MultiSync 3D monitor.

Only the AIR motherboard seemed unfamiliar, but it included the Chips and Technologies chip set and AMI BIOS that are virtually standard equipment on today's high-powered computers. AMI's setup lets you accomplish just about everything, including diagnostics, using software embedded in ROM. You can plug up to 16MB of 1MB SIMMs into the motherboard; it won't accept 4MB SIMMS, and no 32-bit card is provided for extra memory. On the plus side, the motherboard lets you switch operating speeds from 25 to 15 to 8 MHz using the keyboard or the front-panel turbo switch.

SAI's case and workmanship weren't quite up to the highest standard you can find elsewhere. We repeatedly had to wrestle with the case to get the top off, and the second serial port and game port attached to the I/O card were mounted in a way that wasted a slot rather than being on extra openings in the back of the case.

The machine came with separate manuals for each of its components but no unified manual for the entire computer. In all fairness, though, anyone on the market for a 486 machine probably won't need a manual at all.

The machine that PC Labs tested probably won't match the one you buy. SAI has plans to replace the motherboard with a newer model using a whopping 256K of processor RAM cache for improved performance in real-world applications. One thing that won't change—and shouldn't—is SAI's one-year warranty on parts and three-year warranty on labor. To SAI's credit, for the first 60 days, it will ship you a replacement for any defective part before you send back the broken one.

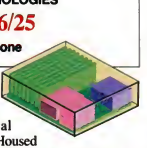
The SAI 486/25 has many attributes to recommend it, not the least of which are its fine selection of quality components and its satisfying service policies. This is the kind of computer you can plug in and forget about—even though it's running faster than any other PC you've ever owned.

SAI has plans to replace the motherboard in its 486/25 with a newer model using a whopping 256K of processor RAM cache.

SWAN TECHNOLOGIES

Swan 486/25

by M. David Stone



By most measures, the Swan 486/25 represents the typical 486 machine. Housed in an AT-size case with the usual five half-height drive bays and built around a Micronics motherboard, the Swan shares its basic design with any number of other 486 systems. But it offers one feature that you won't find in many of its near twins: its low price.

For $6,024, the Swan unit goes slightly beyond *PC Magazine*'s standard configuration but remains one of the more affordable systems in our review. It includes 4MB of RAM, 64K of external cache, a 110MB hard disk, both 5.25- and 3.5-inch floppy disk drives, 16-bit VGA card and monitor, one parallel and two serial ports, and one year of on-site service through TRW. As tested with a 170MB Imprimis hard disk, Swan's Super VGA card, and a Mitsubishi Diamond Scan monitor, the list price totals $6,599.

Swan Technologies' Swan 486/25 performs in the top third on most benchmark tests. At the same time, this $6,024 desktop unit is right in the thick of the fray from a price perspective. One year of on-site service is standard.

The modestly named Swan Super VGA video card, actually a Tseng 8926 card, offers not only VGA and Super VGA modes but interlaced 8514/A capability as well. The Mitsubishi monitor cannot handle the adapter's 8514/A-level resolution, but it will display signals from VGA level through 800 by 600 resolution.

Swan, like many other direct marketers, offers a number of recommended configurations. All of its preferred choices come with a Swan Super VGA card and a Panasonic PanaSync C1381 multifrequency color monitor. The PanaSync monitor costs the same as the Mitsubishi in the system we reviewed, but it handles specific fixed frequencies rather than the Mitsubishi's wide range, and it works in the 8514/A interlaced mode in addition to Super VGA and VGA modes.

The system unit offers the usual reset switch and keyboard lock on the front panel but lacks a turbo switch. According to Swan, if you try to change speeds when the 80486 chip is in burst mode, you risk hanging the system. Although hangups wouldn't happen often, Swan chose to

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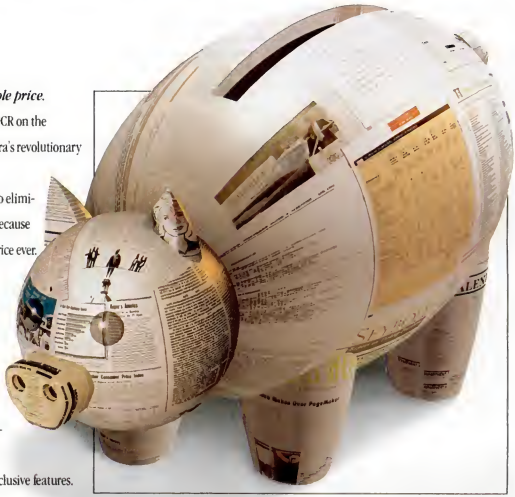

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CIRCLE 522 ON READER SERVICE CARD

eliminate the risk by taking away the ability to switch speeds while in an application. To change speeds, you have to run a disk-based utility program.

Inside the box, you'll find a Micronics motherboard that includes the 80486-25 chip along with a combination of discrete logic and one chip from the Chips and Technologies chip set, plus a socket for a Weitek 4167. As with other systems that use the Micronics board, the tested unit included a 386 Phoenix BIOS. Unlike some other vendors, however, Swan promises that it will send the 486 BIOS automatically when it becomes available. Owners will have the choice of installing the new BIOS themselves or having TRW do it.

The reviewed unit's 4MB of RAM arrived in the form of four 1MB SIMMs, using 80-nanosecond chips. The motherboard provides 16 SIMM sockets, for a maximum total of 16MB RAM. You can configure external RAM cache as 64K, 128K, 256K, or none. The test unit came with the minimum cache that Swan provides: 64K of 25-ns. static RAM. PC Labs' tests suggest that, for DOS at least, the amount of external cache doesn't translate into much of a performance difference, so there is little reason to pay for any additional cache RAM.

The Micronics board contains eight 16-bit slots. The video board fills one slot, while an Adaptec AHA 1542A SCSI disk controller and a parallel/serial board with one 9-pin serial port and one 25-pin parallel port occupy two other slots. The second serial port mounts into one of the four cutouts on the back panel and attaches to the parallel/serial board by ribbon cable.

On PC Labs' benchmark tests, the Swan 486/25 scored some of the fastest times for video tests and some of the slowest for disk tests. On processor and memory tests, it ran about the same as the other systems. Overall, the Swan's performance rates as somewhat better than average, and with the relatively low price, that translates to a better-than-average value. Its FCC Class A rating gives it one important limitation, but if you're looking for an aggressively priced system for the office, this Swan will fly.

PC MAGAZINE FACT FILE

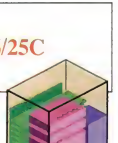
Swan 486/25
Swan Technologies, 3075 Research Dr., State College, PA 16801; (800) 468-9044, (814) 234-2236
List Price: With 4MB RAM, 64K processor RAM cache, 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, one parallel and two serial ports, DOS 4.01, $4,499; with 110MB hard disk, VGA monitor, $6,024; with 170MB hard disk, super VGA monitor, $6,599.
In Short: Low price, better-than-average overall performance, and one year of on-site service combine to make a strong argument for the Swan 486/25 desktop system. Its only limitation, an FCC Class A rating, means the system is licensed only for office use.

CIRCLE 548 ON READER SERVICE CARD

SYNTREX INC.

Syntrex 486/25C

by Bill O'Brien



The Syntrex 486/25C wins this issue's award for the largest enclosure ever to wrap around a computer: the Brobdingnagian tower is fully twice the width of mere mortal towers and a third longer as well. The system isn't built to achieve new processing performance heights in a single-user environment, but instead it offers the storage and board expansion space required for a file server in a distributive processing environment.

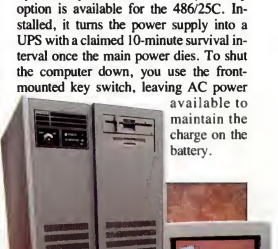
The price of this giant's standard configuration is an equally whopping $11,119, including normal 486 amenities like 4MB of 80-nanosecond system RAM in 1MB SIMM packaging, 32K of 25-nanosecond processor RAM cache (the maximum external cache available to the system), a 150MB Maxstor ESDI hard disk, a 5.25-inch floppy disk drive, one parallel and two serial ports, a VGA monitor, and DOS. Syntrex departs somewhat from the norm in that it uses a portion of the Chips and Technologies 80486 chip set as well as discrete components to manage the cache. The tested configuration, with an additional floppy disk drive, has a list price of $11,900.

The platform for the machine is a Syntrex motherboard using a Phoenix BIOS. As with some of the other machines in the review, the BIOS date is a slightly old and bothersome 1/15/88, which is hardly commensurate with the time line of 486 development. In fact, the motherboard appears to be a mix of old and new styles, with the i486 mounted on its own platform and installed over the original i386 socket.

What makes this motherboard stand out is its ten I/O slots. Three 8-bit and six 16-bit slots give the Syntrex 486/25C its chosen identity as a file server with plenty of room for network boards. A single 32-bit proprietary slot lets the system achieve its maximum 32MB of memory, which is double the capacity of many of the machines we examined. The tower enclosure also seals the 486/25C's fate as a server, providing sufficient open space to house ten half-height or five full-height devices.

In addition to its large size, the Syntrex is credibly endowed with other special appointments to suit its main function. A large toggle switch on the back panel controls the AC power into the box. On the front panel, a keyed switch turns DC input to the motherboard on and off. Part of the reason for this arrangement is the power supply, which bears the Syntrex logo and has a 275-watt rating, making it more than able to satisfy ten hungry I/O boards.

An LED on the computer's front panel labeled "low battery" was a puzzle until Syntrex explained that a battery backup option is available for the 486/25C. Installed, it turns the power supply into a UPS with a claimed 10-minute survival interval once the main power dies. To shut the computer down, you use the front-mounted key switch, leaving AC power available to maintain the charge on the battery.



An extremely powerful machine for large network operations is the Syntrex 486/25C. Its $11,119 price tag puts it out of range for most single users, but its additional network environment features give it an edge as a workhorse server.

FACT FILE

Syntrex 486/25C
Syntrex Inc., 246 Industrial Way West, Eatontown, NJ 07724; (201) 542-1500.
List Price: With 4MB RAM, 32K processor RAM cache, 150MB hard disk, 1.2MB 5.25-inch floppy disk drive, monochrome VGA monitor, one parallel and two serial ports, DOS 4.01, $10,999; with VGA display, $11,119; with 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, $11,900.
In Short: Compared with other 486s, the Syntrex 486/25C is priced out of the single-user market, but its additional features aimed solely at network environments give it an edge over most of the reviewed machines as a network server.

CIRCLE 549 ON READER SERVICE CARD

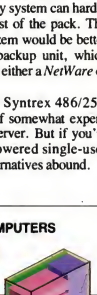
While the $10,999 basic configuration uses a monochrome video system (more than adequate for the type of access on a file server), the tested 486/25C arrived with a Paradise VGA card and a Mitsubishi Diamond Scan 14-inch monitor. Syntrex has not implemented either system or video BIOS shadowing (de rigueur for single-user systems but not necessary for network servers), and without the benefit of the latter, the display system can hardly keep pace with the rest of the pack. The price of this video system would be better spent toward a tape backup unit, which Syntrex can supply for either a *NetWare* or *VINES* system.

The design of the Syntrex 486/25C makes it an obvious if somewhat expensive choice as a file server. But if you're looking for a high-powered single-user system, less costly alternatives abound.

TRANSOURCE COMPUTERS

Verxion 486

by Bruce Brown



Computers that act as network file servers or multiuser systems need plenty of expansion room and larger-than-normal power supplies with adequate cooling provisions. Transource Computers' Verxion 486 is just such a machine, with one fan built into the extra-large power supply located at the top rear of the case and the other on the bottom front of the computer. The machine also offers better-than-average benchmark test scores, aggressive pricing, and standard on-site service by TRW in case of problems.

The Verxion 486 comes in a big tower case that measures 25 by 7.5 by 16.75 inches, with a recessed top-mounted handle. Our tested configuration ($5,575) included 4MB RAM, a 150MB 16-millisecond Seagate hard disk, both 5.25- and 3.5-inch TEAC floppy disk drives, a 16-bit Super VGA Western Digital 1,024 by 768 interlaced display adapter with a Voltron 5156 Super VGA monitor, one parallel and two serial ports, a Monterey International 101-key keyboard, and DOS 4.01.

Armed with two cooling fans in its large tower case, the Verxion 486 from Transource Computers tackles any file server task. The aggressive $5,295 price gets you our standard configuration and an on-site service contract.

Transource will downgrade the system to our standard configuration, if you so desire, with a 100MB hard disk and a plain VGA display adapter, and will sell it to you for $5,295, but recommends starting with a minimum system configuration similar to that of our tested machine for this class of computer.

Transource uses an AIR motherboard with discrete logic circuitry and an AMI ROM BIOS with setup in ROM and selectable system and video ROM BIOS shadowing. In addition to the 80486 chip's internal 8K cache and floating-point circuitry, the Verxion makes provisions for up to 128K external RAM cache memory (which was included on the tested machine) and a socket for a Weitek 4167 math coprocessor.

All memory in the Verxion 486 is plugged into the motherboard. The system uses interleaved fast page-mode memory with 80-nanosecond 1MB SIMMs. At press time, Transource would upgrade the system to 8MB for an additional $320 and to the full 16MB for $960.

FACT FILE

Verxion 486
Transource Computers, 2033 W. North Ln., #18, Phoenix, AZ 85021; (800) 733-8101, (602) 997-8101.
List Price: With 1MB RAM, 128K processor RAM cache, 20MB hard disk, 1.2MB 5.25-inch floppy disk drive, monochrome monitor, one parallel and two serial ports, $4,020; with 4MB RAM, 100MB hard disk, VGA monitor, DOS 4.01, $5,295; with 150MB hard disk, 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, super VGA monitor, $5,575.
In Short: Transource's big tower-case Verxion 486 combines good expansion room with aggressive pricing. Two cooling fans, a company orientation toward big machines, and an included on-site service contract are additional reasons to check this one out.

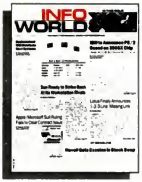
CIRCLE 550 ON READER SERVICE CARD

In addition to the Verxion 486's full set of eight 16-bit interface expansion card slots, the case has room for six disk drives. Four half-height drives can be stacked one on top of the other, all of them using removable media. There's room for a full-height drive without an exposed front; the same space can handle two half-height units. The 230-watt power supply has five device power leads, which should be sufficient.

The Verxion 486 generally fared well on our benchmark tests. The BIOS Disk Seek score was a little low because of the lack of a caching controller; the video scores were also somewhat low, but still within the range of expectations for this class of machine.

Transource sells computers both directly and through dealers and other vendors. The Verxion 486 comes with a standard one-year parts-and-labor warranty, with an on-site service contract good for computers located within 560 miles of any TRW service center, encompassing most of the U.S. population.

The Verxion is fine for a relatively low-cost 486-based file server. While there's nothing outstanding about this machine, there are no negative surprises either. If you need a file server with decent expansion room, a good price, and standard on-site service, the Verxion is a likely candidate.



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Of course, you'll be able to operate one PC from another with CO/Session 5.0. But now we've added such features as reduced memory requirements, remote mouse support and faster screen updates. In fact, with a long list of new features not found in Carbon Copy Plus, pcAnywhere or Close-Up, we're leaving the competition further and further behind.

To find out more about CO/Session and how to order and where to buy it, call 1-800-322-9440. We'll be happy to talk with you – and you'll be glad you called.

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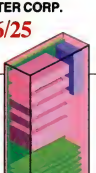
TRI-STAR COMPUTER CORP.

Tri-Star 486/25

by Bruce Brown



When a tower-case computer comes with its own set of wheels, you can tell right off that it's probably heavy. Your second impression should be that the addition of wheels is a thoughtful touch. On the Tri-Star 486/25, you'll find many equally pleasing design points. When you also discover that the Tri-Star machine is very aggressively priced and backed by an exceptional service and support policy mix, it becomes clear that this computer deserves your attention.

The Tri-Star stands out with a well-stocked $5,555 standard configuration including 4MB RAM, 64K external RAM cache, a Maxtor 207MB 15-millisecond hard disk, two floppy disk drives, a super VGA monitor, one parallel and two serial ports, a 101-key Nan-Tan keyboard, and DOS. Even our test system was a good deal: at a $6,995 list price, it incorporated a 256K cache, a 16-bit video adapter with 1,024 by 768 resolution, and a 16-inch Super VGA monitor capable of 1,280 by 800 resolution. Among the features of the stripped-down basic configuration ($4,295) are a Hercules-compatible monographics display adapter and monochrome monitor (these are all you'd need for a file server).

Tri-Star Computer Corp.'s towering Tri-Star 486/25 is a serious file server with a noteworthy price/performance ratio. With 4MB RAM, two floppy disk drives, a Super VGA monitor, and a whopping 207MB hard disk, the list price is a very reasonable $5,555.

The Tri-Star 486/25's case measures 25 inches high by 8.5 inches wide (12.5 inches with a detachable base plate) and 25 inches deep. It comes loaded with conveniences. Besides two sets of double wheels on the bottom front of the case, there are retractable stainless-steel handles on the top and bottom of the back of the case. To move the system unit (after unplugging, of course), just pull out the top rear handle, tilt the case forward a bit, and roll it to the new location. The bottom handle, meanwhile, acts as an additional supporting foot. The system access door shows equally intelligent design: instead of unscrewing and removing the top and side of the case, you merely loosen three screws and swing the side cover sideways on sturdy hinges.

Aggressively priced and with a fine service and support mix, the Tri-Star 486/25 deserves your attention.

Tri-Star uses a motherboard of its own design in this machine, with discrete 486 logic chips and AMI ROM BIOS. This AMI version allows no system or video ROM BIOS shadowing. The processor runs at either 10 or 25 MHz, and the expansion bus at a steady 10 MHz. In addition to the 80486 chip's internal 8K cache, the system uses an external RAM cache, the size of which ranges from 64K to 256K.

System memory is split, with up to 8MB on the motherboard. If you want to expand to the system maximum of 16MB, Tri-Star sells a 32-bit memory expansion card (which can hold another 8MB) for $175 without memory; extra memory is available for $100 per megabyte. The system uses standard row/column memory in 80-nanosecond 1MB SIMMs.

The Tri-Star 486/25 fared well on our benchmark tests, emerging within the expected range on all tests. It did fall a bit short on the video test scores, however, because of the lack of shadowing.

You could get very busy expanding this machine's capabilities. In addition to the single 32-bit proprietary slot for the second 8MB of system memory, the Tri-Star has seven 16-bit expansion slots. (Because I/O circuitry is built into the motherboard, the tested system used only a video card and a drive interface card.) There are also nine knockouts for 25-pin I/O ports and eight 9-pin knockouts.

The Tri-Star's case holds a maximum of six drives, with five half-height drive bays for removable media and an additional large bay, which in the test machine was equipped with brackets for a 3.5-inch hard disk. The power supply puts out 250 watts and has six device power leads; two fans inside the machine provide ample cooling.

Tri-Star sells by direct marketing only but has an outstanding service and support mix. The standard warranty covers parts and labor for two years; the company also provides lifetime toll-free technical support, telephone service with shipping of replacement parts, and a standard one-year on-site service contract through TRW. Other features include a 60-day money-back guarantee and a motherboard upgrade policy with discounts of up to 55 percent during the first year. Tri-Star guarantees to ship standard-configuration

PC MAGAZINE FACT FILE

Tri-Star 486/25
Tri-Star Computer Corp., 707 W. Geneva Dr., Tempe, AZ 85282; (800) 678-2799
List Price: With 1MB RAM, 64K processor RAM cache, 65MB hard disk, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, Hercules-compatible monitor, one parallel and two serial ports, $4,295; with 4MB RAM, 207MB hard disk, 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, super VGA monitor, DOS 3.3 or 4.01, $5,555; with 256K processor RAM cache, 16-inch super VGA monitor (1,280 by 800 resolution), $6,995
In Short: The Tri-Star 486/25 comes in a big tower case with several quality physical-design features such as wheels and sturdy handles. The performance is right on the mark, expansion is good, and the price and service/support mix are terrific.

CIRCLE 601 ON READER SERVICE CARD

AFTER 15 YEARS
IN THE COMPUTER BUSINESS,
TANDON OPENS 426 MILLION
LOCATIONS NATIONWIDE.

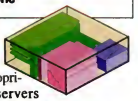
machines within 72 hours, via next-day service, for a flat $89 charge.

You'd probably find it hard to justify having this machine just for a single user; its intent as a file server or multiuser machine is clear. Some of the design elements are so user-considerate that you might want one just for yourself anyway. With better-than-average expansion room, very good support policies, and impressive pricing, the Tri-Star 486/25 will probably find its way to many offices this year.

TWINHEAD CORP.

Twinhead Superset 600/425

by M. David Stone



Some users view 486/25 computers as being more appropriate as network servers than as small-footprint desktop systems. The Twinhead Superset 600/425 is for those who feel otherwise. Measuring just 5.1 by 15.75 by 15.75 inches, the system gives you 486 power while using a minimal ration of desktop real estate.

Because its built-in Super VGA video controller (800 by 600 resolution) goes beyond VGA, Twinhead Corp.'s machine doesn't exactly fit our standard configuration for price comparisons of 486/25 machines. The $6,995 system provides the closest approximation, but the Relisys monitor you get at that price does limit the system to VGA. The configuration includes 4MB of RAM, 64K of system cache, a 104MB hard disk, one 5.25-inch floppy disk, and one parallel and two serial ports. The $7,410 tested unit offered 8MB RAM and a 142MB Imprimis hard disk. All systems arrive bundled with DOS 4.01, *Microsoft Windows* 3.0, and *Super PC-Kwik* 1.54. Prices include one-year on-site service through Nationwide Warranty Corp.

The Superset 600/425 chassis offers an unusual drive bay arrangement, with room for one full-height 3.5-inch drive and either two one-third-height drives and a half-height drive or a one-third-height drive and a full-height drive. The reviewed unit came with a 3.5-inch hard disk and a one-third-height floppy disk drive installed, leaving the half-height bay and a one-third-height bay open.

Twinhead also uses an unusual design inside the box. It consists of an active backplane, a processor board, and a T-bar board with four 16-bit expansion slots, all of which sat empty on the reviewed system. The backplane is actually a 386 system board, complete with sockets for an 80386 chip and a coprocessor, and much more. It also contains the Chips and Technologies chip set, the 486 version of the Phoenix BIOS, the parallel port and both serial ports, support for two floppy disk drives and two IDE hard disks, a Super VGA controller, and eight SIMM sockets. Twinhead often sells the unit as a 386 system that can be upgraded to a 486 for $1,995. You just plug in the 486 card, remove the 80386 chip, and change the BIOS. The company also plans to offer a 33-MHz 486 card as an option, and it may be available by the time you read this.

The Super VGA controller on the system board comes in the form of a Paradise chip set and video memory, but if you prefer you can disable the on-board video and add a video card instead. The eight SIMM sockets on the system board permit a maximum of 8MB of RAM, and on the tested system, 1MB SIMMs using 80-nanosecond chips filled all eight of the sockets. A designated slot for an optional memory board offers eight more SIMM sockets, bringing the system maximum to 16MB.

With so much on the system board, the processor board's only remaining points of interest become the 80486 chip and 64K of 25-ns. external cache. Notable for its absence on the processor board is a socket for a Weitek 4167. The system board does provide a coprocessor socket that fits a Weitek 3167, but Twinhead points out that the 486's built-in coprocessor runs faster than the 3167.

The Twinhead Superset 600/425 from Twinhead Corp. packs a lot of power into a small-footprint box. At $6,995 for our standard configuration, and with its FCC Class B certification, this could be the power user's home-office choice.

If you need the 4167's heavy-duty number crunching, you'll regret the lack of support for it, but for most tasks the system's performance should be acceptable. On processor and memory tests we saw little difference among the systems tested, and that included the Superset 600/425. On video tests, it scored in the midrange or a little better. On disk tests, it fell on the low side of average. But as with all the machines we evaluated, you can get better results by replacing the disk drive, running a disk caching program, or substituting a caching controller.

Clearly, the Twinhead Superset 600/425's design hinders it from filling the role of a network server with lots of drive bays or a CAD workstation with Weitek 4167 support. But then those obviously aren't the kinds of applications Twinhead intended for it. If you're the sort of power user who wants the latest and greatest on your desk, and you like to have it in a small-footprint package, this system is well worth your interest. As a bonus, it offers Class B certification, making it a good choice for a home office. ■

Bruce Brown, Edward Mendelson, Bill O'Brien, Alfred Poor, Jim Seymour, *and* **M. David Stone** *are contributing editors of* PC Magazine.

PC MAGAZINE **FACT FILE**

Twinhead Superset 600/425
Twinhead Corp., 1537 Centre Pointe Dr., Milpitas, CA 95035; (800) 945-8946, (408) 945-0808.
List Price: With 1MB RAM, 64K processor RAM cache, 1.2MB 5.25-inch floppy disk drive, VGA monitor, one parallel and two serial ports, DOS 4.01, *Microsoft Windows* 3.0, *Super PC-Kwik* 1.54, $5,794; with 4MB RAM, 104MB hard disk, $6,995; with 8MB RAM, 142MB hard disk, $7,410.
In Short: This small-footprint system offers built-in Super VGA, one-year on-site service, and a promised ability to upgrade to a faster processor board. Too few drive bays make it the wrong choice for a server, but the Class B certification puts it in the running for a power user's home office.

CIRCLE 602 ON READER SERVICE CARD

VISIT THE ONE NEAREST YOU.

When Tandon entered the computer business 15 years ago, most users only wanted price/performance. That's what we delivered. And today there are more than 600,000 Tandon systems installed worldwide.

Now state-of-the-art products aren't enough. You want a choice in how you purchase, service, and support your computers. So we're responding with the state-of-the-art in customer satisfaction. Now you can choose how you purchase and service your computers: direct from Tandon or through a Tandon business partner (resellers/dealers).

Either way, you get outstanding Tandon systems featuring innovative Tandon technology. Robust, reliable, price-competitive computers that have made Tandon's 5-year sales growth greater than even Compaq and Apple. Technologically advanced computers that lead the industry in power and performance. Computers that must pass stringent manufacturing and quality checks before they wear the Tandon label.

And you choose the level of service and support that's tailored - and priced - to your specific needs.

Buy direct from Tandon and you've got our promise of helpful, knowledgeable, no-pressure sales assistance, prompt delivery, telephone technical support, one-year limited warranty, and a no-exceptions 30-day moneyback guarantee.

Buy from an authorized Tandon business partner, and you'll be working with fully-trained systems professionals, ready to provide everything from planning, installation, training and support services to applications development, system customization, network design, and multi-vendor solutions.

Take a close look at the outstanding lineup of Tandon computers featured in the following pages. Then call us. We'll not only help you select the system that's right for you. We'll help you select the best way to buy it.

A COLORFUL REASON TO ORDER BEFORE SEPTEMBER 30.

With each Tandon system you buy before September 30, 1990, we're enclosing a 10-pack of premium-quality Tandon diskettes in a rainbow assortment of colors. Once you experience the convenience of Tandon color-coded diskettes, you'll want more, so re-orders are available in quantity.

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CIRCLE 541 ON READER SERVICE CARD

BRIGHT ENOUGH

STANDARD FEATURES

3.5-inch high-density, double-sided 1.44 MB diskette drive also reads 720 KB diskettes.

40 MB IDE hard drive.

(LT 386sx) 16 MHz 80386SX processor; (LT 286) 12 MHz 80C286 processor; keyboard selectable clock speeds.

1 MB memory, diskette drive, video controllers, IBM®-compatible parallel and RS-232-C serial ports, optional math co-processor socket on main board.

Built-in single screen system setup utility automatically configures diskette drive, security, standby mode, ROM shadowing, serial and parallel options; easy selection of security levels, external peripherals, and routine functions such as date, time, language, etc.

Monochrome backlit liquid crystal (LCD) video display with 16 shades of gray can be set to write dark characters on light background, or light characters on dark. I/O port supports external color or monochrome VGA™ (LT 386sx) or EGA™ (LT 286) monitor.

82-key keyboard emulates 101-key keyboard with embedded keypad and 12 function keys; password security; supports external keyboard and 10-key keypad.

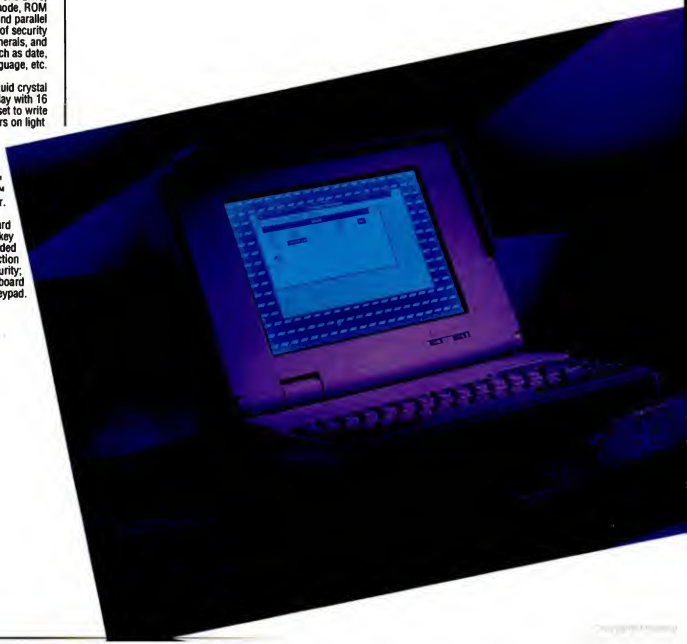
TANDON LT 286™: LAP UP THESE FEATURES. ~~$2,499.~~

Special introductory price*: $1,999. Save $500.

The Tandon LT 286 features many of the innovations that we've built into the Tandon LT 386sx. All of which makes for an outstanding 286-based laptop. In fact, our dual-panel LCD technology delivers an EGA video refresh rate which *PC Magazine* reports is "among the fastest in its class."

Tandon's innovative selectable ROM shadowing is also incorporated in the Tandon LT 286, providing significantly faster execution of ROM-based instructions.

Add the same energy conservation features we provide on our LT 386sx, and you've got more than a laptop you can live with. You've got a laptop you'll love. Call today and lap one up.



TO GO PLACES.

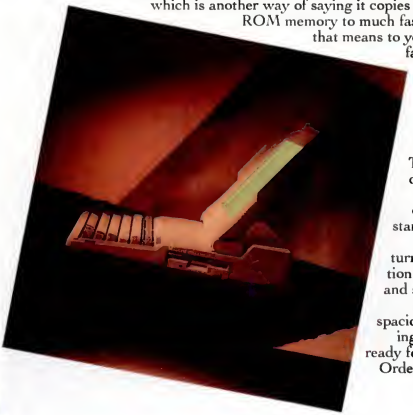
TANDON LT 386sx™ PUTS A HANDLE ON POWER. ~~$2899.~~

Special introductory price*: $2,499. Save $400.

Even most desktop systems don't pack the power of Tandon's LT 386sx laptop. Beneath the sleek, slim case, a full 32-bit internal 386SX™ processor purrs confidently at 16 MHz. Accompanied by a generous 40 MB hard disk, 1 MB RAM (expandable to 5 MB,) and rechargeable battery.

The backlit VGA monochrome display provides outstanding graphic resolution, with up to 16 shades of gray, and operates with light-on-dark, or dark-on-light characters, as you prefer. Dual-panel LCD technology not only makes the display one of the brightest of any laptop, but refreshingly fast on video refresh - a significant consideration for users of Microsoft Windows™, CAD software, desktop publishing, and the other powerful graphic applications for which theTandon LT 386sx is eminently suitable.

A unique Tandon innovation provides selectable ROM shadowing, which is another way of saying it copies instructions from ROM memory to much faster RAM. What that means to you is significantly faster execution of ROM-based instructions.



Energy conservation is on everyone's mind these days. The Tandon LT 386sx does its part, with selectable lower clock speeds, and standby mode: automatic or manual turnoff and reactivation of the hard drive and screen as needed. Add the optional spacious, stylish carrying case, and you're ready for a power lunch. Order in your Tandon LT 386sx today.

STANDARD FEATURES (cont.)

LED indicators for low battery, fixed and diskette drive operation, keyboard status (Num, Caps, and Scroll Lock).

Proprietary 16-bit expansion slot with AT®-bus and RS-232-C signals.

Autosensing AC adapter/charger accepts 100 to 265 VAC input; Nickel-Cadmium battery pack provides 2 to 3 hours portable operation, depending on battery conservation techniques employed.

Built-in speaker with programmable, IBM-compatible sound.

Dimensions: 12.7 in. wide by 13.6 in. deep by 3.4 in. high. Weight 14.5 lbs.

System unit and power/adapter cord, operation and installation manual, Tandon MS-DOS 3.3 loaded on fixed disk.

OPTIONAL FEATURES

Custom fabric carrying case, 2 MB memory modules (to 5 MB total), external numeric keypad, external 5.25-inch diskette drive, Tandon MS-DOS diskette and manual, Windows™3.0

Tandon LT 386sx/40, VGA: $2,899
Introductory price: $2,499

Tandon LT 286/40, EGA: $2,499
Introductory Price: $1,999

***Introductory price offer good until August 31, 1990**

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CIRCLE 312 ON READER SERVICE CARD

THE THIN LINE THAT SEPARATE

STANDARD FEATURES

3.5-inch high-density, double-sided 1.44 MB diskette drive, or 5.25-inch 1.2 MB diskette drive.

Two-speed 8/16 MHz 80386SX processor (SL 386sx); Two-speed 8/25 MHz 80486 processor (SL 486); keyboard selectable clock speeds.

1 MB memory, diskette drive controller, video controllers, IBM-compatible parallel and two RS-232-C serial ports, optional math co-processor socket on main board.

Built-in single screen system setup utility automatically configures diskette drive, security and serial and parallel options; easy selection of security levels, external peripherals, and routine functions such as date, time, language, etc.

Universal 101-key enhanced layout, low profile with 12 function keys; LED indicators for Num Lock, Caps Lock, and Scroll Lock Keys; password security.

TANDON SL 386sx™ PUTS POWER ON YOUR DESK WITHOUT TAKING IT OVER. $2100.

We've combined Intel 80386 power, technology and features with unique Tandon innovations to deliver outstanding performance in a compact, slimline package.

Full 32-bit internal processing means that the Tandon SL 386sx (the SL stands for slimline) will run your existing applications faster. While its advanced instruction set lets you also move up to advanced multitasking software and applications, such as Windows 3.0. Of course, all 386SX systems will do that. Here's why ours does it better:

A proprietary Tandon chip called MIAT™ (which stands for Mapper-Integrated AT) provides a higher level of systems integration. But don't let the buzzwords baffle you. What we're talking about is fewer components and greater reliability.

The low profile, small footprint package doesn't dominate your desk, yet contains more than enough internal expandability for most applications. For which you can thank another aspect of the Tandon SL 386sx: communications ports, mass storage controllers and an optional VGA graphics interface are all resident on the main board.

And that's enough innovation to keep most users happy for a long, long time.

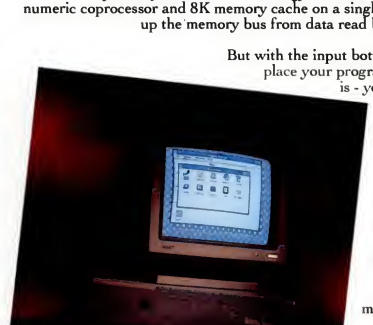
S US FROM THE COMPETITION.

TANDON SL 486™ IS ABOUT AS MUCH POWER AS ONE PERSON CAN HANDLE. $4399.

If computers were cars, this one wouldn't be designed yet. We've put the awesome power of the Intel 80486™ chip in a slimline package to produce the ultimate single-user power machine. Not to mention an extremely economical way to put 486 technology at your fingertips. And it's no slouch when it comes to networking, either.

As you may know, 486 technology combines the 80386 instruction set, numeric coprocessor and 8K memory cache on a single chip. All of which frees up the memory bus from data read bottlenecks, and results in faster operation.

But with the input bottleneck removed, the next place your programs can get bogged down is - you guessed it - output. So in the Tandon SL 486, we've added an exclusive new feature to nip that problem in the bud: the PowerPoster™. This is our brand name for an intelligent buffer that speeds write operations to RAM. Another advantage of the PowerPoster is that it eliminates the need for the more expensive external cache memories found on some of our competitors' 486 systems. And leads a step closer to the Holy Grail of computer design: greater price/performance.



The Tandon SL 486 also incorporates two other Tandon innovations that we hope you're becoming familiar with: Tandon's Memory Mapper, providing Shadow RAM for faster processor performance, and the MIAT chip for greater integration, and resulting higher reliability.

If you're a power user considering a high end 386-based system for compute-intensive applications such as CAD, graphics, or large spreadsheets, the Tandon SL 486 was designed to win you over.

STANDARD FEATURES (cont.)
Two 5-1/4 inch and one 3-1/2 inch drive bays.

Personal password protects dat and software.

Three 16-bit AT-compatible expansion slots and one XT™ compatible slot.

130-watt, fan-cooled power supply; switchable to 115 volts 230 volts.

Built-in speaker with programmable, IBM-compatible sound.

Dimensions: 18.3 in. wide by 16 in. deep by 5 in. high.
Weight 31 lbs. (SL 386sx); 32 lbs. (SL 486).

System unit, keyboard, power cord, operation and installation manual, Tandon MS-DOS software and manual.

OPTIONAL FEATURES

Memory modules (to 5 MB total Windows 3.0, 80387SX math co-processor (SL 386sx); 110 MB or 200 MB IDE fixed disk.

Tandon SL 386sx $2,100.
Tandon SL 486 $4,399.

Both systems include
1 MB RAM, 40MB IDE drive,
VGA monochrome monitor,
16-bit video card.

(800) 800-885(

Canada: (800) 359-8263
Outside Continental US: (805) 523-034

Tandon

Where it pays to be direct

CIRCLE 508 ON READER SERVICE CARD

WARP FACTOR

NEXT TO THE TANDON 486™. EVERYTHING ELSE IS A SECOND-RATE POWER. $6599

The Cold War may be over. But the computer war is just heating up. And the balance of power has definitely shifted to the Tandon 486.

That's because we've pulled out all the stops. And combined Intel 80486 technology with unique Tandon innovations to create a machine that *PC Computing* calls "a hot ticket for performance junkies."

Unlike 486-based systems with plug-in CPU boards, we designed the Tandon 486 from the ground up around the Intel 80486 processor. We not only support burst mode read cycles (which can almost double data input speed), we also incorporate the EISA-specified double-wide (64-bit) memory bus and MultiCACHE™ external cache memory to further accelerate read operations.

But the crowning touch is the way we eliminate output bottlenecks - the Achilles Heel of many other 486 systems. Tandon's proprietary PowerPoster, a smart write buffer, bursts most write operations to RAM. PowerPoster has a cost benefit too, because it reduces the need for large amounts of expensive cache memory.

By offering true workstation performance at personal computer prices, the Tandon 486 has the distinction of being the first superpower to balance the budget.

STANDARD FEATURES

5.25-inch high-density, double-sided 1.2 MB diskette drive; 3.5 inch, high density, double-sided 1.44 MB diskette drive.

386: Two-speed 8/25 or 8/33 MHz 80386 processor, keyboard selectable clock speed. (8/33 only on Tandon Tower).
486: Two-speed 8/25 MHz 80486 processor, keyboard selectable clock speed.

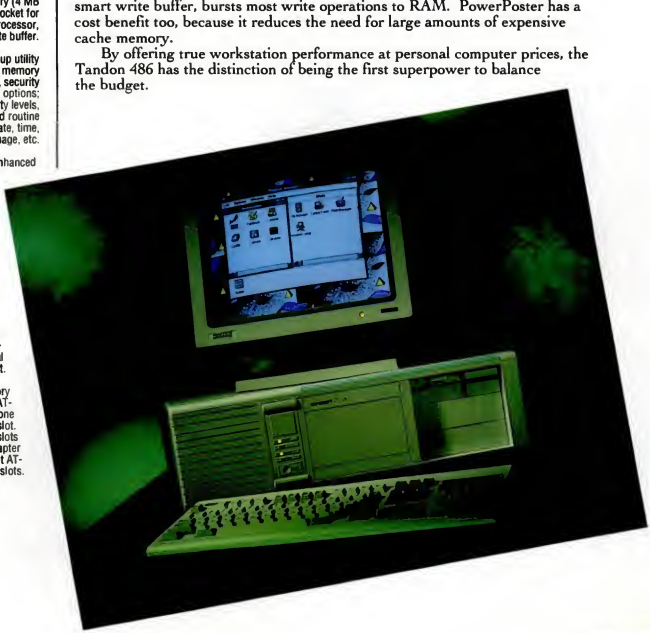
386: 1 MB 32-bit memory, socket for Intel 80387 or Weitek™ math co-processor; 64 KB static RAM cache.
486: 2 MB 64-bit memory (4 MB on Tandon Tower 486), socket for Weitek math coprocessor, PowerPoster write buffer.

Built-in system setup utility automatically configures memory expansion, diskette drive, security and serial and parallel options; easy selection of security levels, external peripherals, and routine functions such as date, time, language, etc.

Universal 101-key enhanced layout, low profile with 12 function keys; LED indicators for Num Lock, Caps Lock, and Scroll Lock Keys; password security.

386: Serial/parallel adapter requires one expansion slot; RS-232-C serial port; IBM-compatible parallel port.
486: Two RS-232-C serial ports and one IBM-compatible bidirectional parallel port.

386: One 32-bit memory slots; six 16-bit AT-compatible slots; one 8-bit XT-compatible slot.
486: Six 32-bit EISA slots (AT-compatible with adapter cards); two 16-bit AT-compatible slots.



9. MR. SULU.

TANDON 386™ TAKES IT TO THE LIMIT. $3799 & $4199.

Tandon's full-function 386 systems take advanced 80386 technology as far as it will go. And that's all the way to a blinding 33 MHz processor speed, with 16 MB of directly addressable memory. All on a 32-bit bus.

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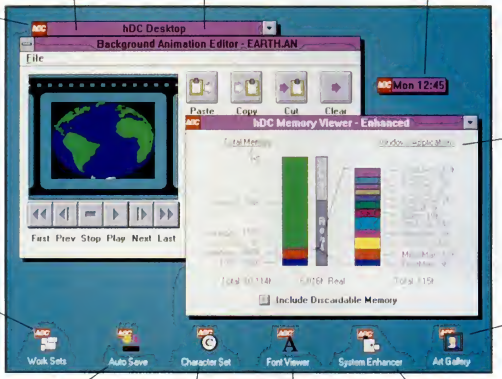

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WINDOWS 3.0 UNDER THE SPOTLIGHT

By bringing the graphical interface within the realm of practicality for millions of DOS PCs, *Windows* 3.0 is certain to have a major impact on the industry's future. Here's an in-depth look at the new standard.

BY WILLIAM S. HALL

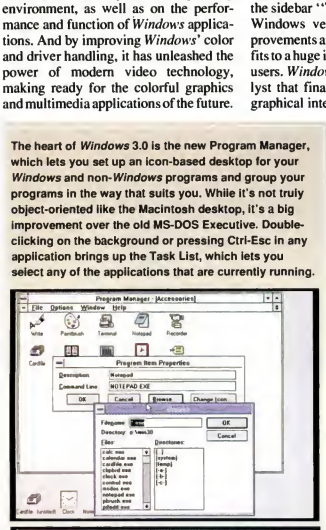
Since it was introduced some five years ago, *Microsoft Windows* has been as much an expression of technological evangelism as a practical product. Though it promised to bring the consistency and usability of the graphical user interface to the PC, the limitations of the PC hardware base and the drag of existing standards have held back its progress. So, although *Windows* has shown a steady growth in popularity that has accelerated rapidly over the past year or so, it has not taken the PC world by storm.

PHOTOGRAPHS: THOM O'CONNOR

Windows 3.0 may change all that. For the first time, *Windows* offers a powerful, productive, and cooperative graphical environment that takes full advantage of today's PCs while remaining compatible with existing DOS applications. The jump in functionality cannot be underestimated. By choosing to run *Windows* 3.0 in protected mode, Microsoft has in a single stroke eliminated the memory barriers that have been the greatest drag on the use of *Windows* as a comprehensive operating environment, as well as on the performance and function of *Windows* applications. And by improving *Windows*' color and driver handling, it has unleashed the power of modern video technology, making ready for the colorful graphics and multimedia applications of the future.

Best of all, the new *Windows* bursts upon a field of over a thousand applications, many of which already support the new version and its advanced features. The new freedom from memory constraints will bring an explosion of advanced products to the PC, including many that have existed only on the Macintosh. Though *Windows* 3.0 is still a far cry from the Macintosh system in overall usability (see the sidebar "The User Interface Faceoff: Windows versus Macintosh,") its improvements are enough to bring real benefits to a huge installed base of 286 and 386 users. *Windows* 3.0 may just be the catalyst that finally pushes PC users to the graphical interface in real numbers.

The heart of *Windows* 3.0 is the new Program Manager, which lets you set up an icon-based desktop for your *Windows* and non-*Windows* programs and group your programs in the way that suits you. While it's not truly object-oriented like the Macintosh desktop, it's a big improvement over the old MS-DOS Executive. Double-clicking on the background or pressing Ctrl-Esc in any application brings up the Task List, which lets you select any of the applications that are currently running.



A NEW LOOK

What a contrast in appearance *Windows* 3.0 presents! On first sight, it's hard to imagine that this attractive desktop of subtle colors, three-dimensional buttons, and multicolored icons is the same program as the flat, brightly colored *Windows* 2 desktop we're used to seeing.

By doubling the number of basic colors from 8 to 16, the standard EGA and VGA display drivers offer two pure shades of gray, as well as six additional low-intensity colors. The results are eye-catching: colors are clear and soft, grays are finely brushed, and dithering is less intrusive. The new proportional system font (used for title bars, menus, and dialog boxes) completes the sleek, professional, and eminently readable appearance.

The new look is more than cosmetic, however. *Windows* 2's utilitarian MS-DOS Executive was justifiably maligned for its insufficiencies, to the point where replacements and enhancements for it have grown to the status of a cottage industry. With *Windows* 3.0, Microsoft has introduced a revamped method of managing programs and files—one that borrows heavily, though not completely, from the design of the OS/2 Presentation Manager.

***Windows* 3.0 bursts upon a field of over a thousand applications, many of which already support its new and expanded features.**

When you first start *Windows* 3.0, you're greeted by the Program Manager, which helps you organize your applications into an easily customizable, icon-based desktop within a desktop. Within the main Program Manager window, you'll find one or more program groups. Each group has its own window: you can size, tile, cascade, or even iconize them, though you can't move them outside the main Program Manager window. This ability to treat document windows within an application as flexibly as you'd treat application windows on the desktop is new to *Windows* 3.0.

MANAGEABLE ICONS

Each group window, in turn, contains one or more application programs represented by icons; double-clicking on the icon of your choice starts the program. The programs may reside either locally or on a network drive; a new browse facility lets you scan through your directories for executable files you want to run. You can assign a descriptive label of up to 40 characters to each icon.

One of the nicest features of the Program Manager is that you can move or copy program icons from one group to another simply by dragging them from the source window to destination program group. An icon may be part of more than one group as a kind, making it easy to set up groups oriented by task or project rather than application type. You can even set up an icon to start an application and open up a specific file. A menu function lets you arrange the icons neatly on the desktop.

You can choose to save the appearance of the desktop automatically when you exit *Windows*.

By default, you start out with Main, Games and Accessories groups, plus *Windows* and Non-*Windows* Applications if you've chosen to have *Windows* search your disk for applications during setup. But you can organize your desktop into as many or as few groups as suits your needs

> ***Windows* 3.0's new File Manager, with its mix of graphical and text-based operations, is still too awkward to be really useful.**

(see the sidebar "The Intelligent Desktop: Making Program Manager Work For You"). Whatever arrangement you choose, it does not affect the underlying structure of your disk, so you can set up groups freely without rearranging your subdirectories.

As with *Windows* 2, you can reduce any running application to an icon on the screen and put it aside for future use. In addition, *Windows* 3.0 offers a menu-based way to select any open application. Double-click on the screen background or press Ctrl-Esc from any application (including full-screen DOS applications), and you'll see the Task List, which lists your running programs and lets you select any one of them. The Task List also lets you cascade or tile the open windows, to arrange the icons, or to shut programs down—very helpful when your *Windows* desktop gets crowded.

FILE DISAPPOINTMENT

A new File Manager complements the Program Manager, but though it's an improvement over the old MS-DOS Executive, its mix of graphical and text-based operations is still too awkward to be really useful. Much like a character-based DOS shell, File Manager starts out with a directory tree display that shows the overall organization of your subdirectories as branches from the root. You can use the Plus and Minus keys or menu commands to expand and collapse branches of the tree. Double-clicking on any subdirectory displays the files in that directory.

Depending on the amount of free memory you have, you can keep several file windows open at one time, tiling them for side-by-side comparison or iconizing them for future reference. Unfortunately, you can have only one directory window at a time, an arbitrary and rather confusing limitation. Though it should be easy to bounce around between the multiple listings, getting all the files up on screen at once requires too many mouse clicks to make it practical as a time-saver.

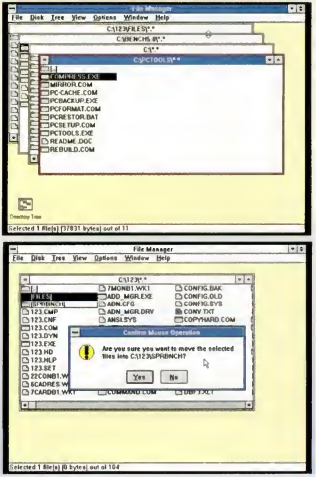
Though the familiar menu commands are available for the tradition-minded, *Windows* 3.0's File Manager now lets you copy or move groups of files graphically, by clicking and dragging them from window to window. The move command is reasonably well designed, enabling you to move files across disks as well as between directories; it even moves entire directories with all their subdirectories and files. A new search command makes it a good deal easier to find files wherever they may be on your disk. But still missing is a convenient way to view their contents or perform detailed comparisons: you'll need to rely on third-party utilities for those functions.

As in the old MS-DOS Executive, you can start programs by clicking on either the executable program files or the data files associated with them. But you can now associate file extensions with particular applications using the menus; you no longer have to edit the WIN.INI file manually. You can also drag data files on top of an application's .EXE file listing to start up the program with that data file loaded.

SNAPPY ACCESSORIES

In the midst of all these changes, Microsoft hasn't forgotten the *Windows* accessories. All of these useful little programs have been brought up to the new look of *Windows* 3.0, including its help files and printer support. In many cases, they have been significantly enhanced as well. The *Windows* Notepad, for instance, can now edit files up to 50K—much more than before. The Clock shows the time in analog or digital format. The Calculator now offers statistical and scientific functions, octal and hexadecimal arithmetic, and a

***Windows* 3.0's new File Manager lets you keep multiple directory windows open at once: you can move, resize, cascade, tile, or iconize any of these windows just as you can with program windows. You can also perform many operations by clicking and dragging: for example, you can move all the files from one subdirectory to another by dragging the file listing of the source directory to the target directory listing. But the File Manager as a whole doesn't go much beyond a character-based DOS shell; it is still far too awkward in its design and requires too many mouse clicks to be much of a timesaver.**



OUR CONTRIBUTORS

Brian Carr is the head of Brian Carr Computer Consulting Corp. (bc[4]) and a former member of the original OS/2 task force at IBM Research.
Frederic E. Davis is director of PC Labs.
William S. Hall is a software engineer who develops *Windows* applications for Novell Corp. He is a contributor to *Programmer's Journal* and writes the Windows column in the Productivity section of *PC Magazine*.
Pamela Livingston (née Milland) is the project leader in charge of graphics and multimedia testing at PC Labs.
Charles Petzold is a contributing editor of *PC Magazine*.
Craig Stinson is a contributing editor of *PC Magazine* and coauthor of the latest edition of *Running Windows*, published by Microsoft Press.

full complement of logical operations. The Terminal program now sports XModem and Kermit file transfer capabilities (though the Kermit facility unaccountably fails to accept wildcards that would let you send more than one file in a batch). And Write now reads *Word for Windows* files.

To better handle the graphics demands of the new environment, Microsoft has replaced *Windows* Paint with a version of ZSoft's popular *PC PaintBrush* program. This full-featured program is a big step up. It has a substantial range of drawing tools, supports full color as well as black-and-white images, and reads and writes .PCX files as well as the *Windows* bitmapped format (.BMP). With it, you can design or modify icons, paste captured *Windows* screens from the Clipboard (PrtSc captures the screen), and create graphics to paste into *Windows* documents. You can also save Clipboard contents directly in the *Windows* .CLP file format. Moreover, the 64K limit on Clipboard contents no longer applies.

Another useful addition is Recorder, a basic macro recorder that lets you capture a sequence of keystrokes and mouse actions in a file for playback. This can be useful for simple tasks such as inserting frequently used text or automating the steps of a routine. Macros can be nested up to five levels deep, and you can store several macros in a single file. Unfortunately, if you make a mistake, you'll have to rerecord the macro, because there's no way to edit the missteps out of the file. Moreover, if you move your icons around, all your recorded mouse actions will be invalid. For these reasons, Recorder is no substitute for a full-scale macro language such as The Softbridge Group's *Bridge*, or the Agent capabilities of Hewlett-Packard's *NewWave* environment.

GREATER CONTROL

Windows 3.0 gives you more facilities for customizing its appearance. The redesigned icon-based Control Panel, which lets you set the options for screen colors, fonts, printers, keyboard and mouse actions, and so on, allows you to fine-tune your desktop to a greater degree than the old *Windows* 2 Control Panel.

Color selection, especially, is much improved. Instead of painstakingly selecting the colors for the workspace, screen background, menu bars, and title bars individually, you can now choose from an array of predefined color schemes ranging from Arizona (earth tones) to Wing Tips. If these don't suit you completely, *Windows*' new color palette manager (of which more later) makes it far easier to find the right colors. You can copy any predefined color scheme and modify any element by selecting from a range of standard *Windows* colors in the palette; you can add any custom color (created by mixing hue, saturation, and brightness, or red/green/blue with sliders) to the palette as well.

With *Windows* 2, the basic screen background came one way: plain. With *Windows* 3.0, you can incorporate patterns or entire bitmapped images (called wallpaper) to spice up the appearance of your screen. Microsoft thoughtfully includes a range of patterns and wallpaper bitmaps to experiment with, and you can design your own wallpaper using the Paintbrush accessory or any other paint program. Though this option is not much of a productivity builder (and the screen can become confusing if your background is too fancy), it's a lot of fun; with a bit of artistry, you can make your *Windows* 3.0 desktop all your own.

EASIER SETUP

Windows is also much easier to install and configure than it used to be. The new Setup program, after an initial stage, is *Windows*-based and uses on-screen windows to step you through the process of copying files and setting up printers. It can even search your disk and install your existing DOS applications for you, though you may prefer to turn this option off and set up specific applications manually.

In the past, once the *Windows* system has been installed by the setup program, it was impossible to reinstall new device drivers for new displays or keyboard layouts except by reinstalling *Windows*. *Windows* 3.0 happily fixes this problem by providing a *Windows* Setup utility to change the display, mouse, keyboard, or network driver within the *Windows* environment.

Printer setup is also much improved. You can now install several printers on

One of *Windows* 3.0's most notable enhancements is its improved color handling. The basic screen drivers now handle 16 colors instead of 8, and a 256-color driver for Video Seven extended VGA cards is also included. The new color palette manager in the Control Panel makes it much easier to get the colors you want. You can choose from among several predefined color schemes, and you can modify any element by selecting from a menu of colors. *Windows* applications can also take advantage of these new color facilities.

the same printer port, facilitating use on networks and with printers that support multiple emulations. And you can easily assign a printer's output to a file; *Windows* will then prompt you for a filename each time you print. The new Print Manager, clearer and easier to use than before, has been greatly enhanced to handle the chores of network printer queues as well as local printers.

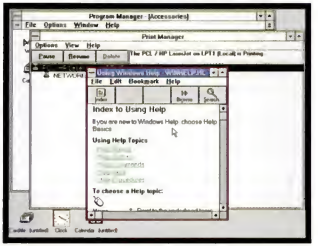
HELP FOR HELP

Windows 3.0 comes with an excellent help system. You can either call help from any *Windows* program that has a help option, or run the help program (WINHELP .EXE) from the File Manager or Program Manager. You can get context-sensitive help by pressing F1. The help window is a separate task that can be treated like any other; you can even iconize it for future reference.

Once the help program is started, large pushbuttons let you select topics from the master index, browse through items in a series of related topics to find any particular topic, or retrace your path through the help topics you've already covered. You can click on any word marked with a dotted underline to get a definition of that term; phrases marked with a solid underline jump to a more detailed explanation.

A search option lets you jump to any particular item directly, and you can set multiple bookmarks anywhere in the help system for quick return to a topic of interest. You can also supplement the help text with your own notes. Annotated screens are marked with a paperclip icon that you can click on to read the notes. Finally, if you want a hard copy of the help text, you can print it.

Like all *Windows* applications, Print Manager benefits from *Windows* 3.0's new help system. Help is now a standalone application that you can run from the File Manager or the Program Manager, as well as call from within an application. It lets you search for key words, set bookmarks for easy backtracking, and print interesting passages for future reference.



BREAKING THE BARRIER

Though the outward changes in *Windows* 3.0 are indeed dramatic, its most important enhancements are underneath. With the appearance of Version 3.0, *Windows* is finally able to break through the 640K barrier to make full use of the extended memory in 286- and 386-based machines. With this improvement, *Windows* becomes far more than a graphical user

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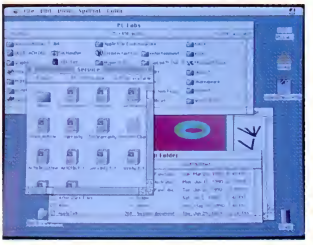
WINDOWS VERSUS MACINTOSH: The User Interface Face-off

By Frederic E. Davis

Some PC partisans are saying that *Windows* 3.0 makes a PC as easy to use as a Macintosh. Apple evangelists assert that the Mac's interface is still much better. Who's right?

Well, in a way, both sides are. *Windows* 3.0 does make a PC work a lot like a Mac. Both interfaces are based on a common system of windows, icons, menus, and dialog boxes that allow the user to interact with the computer by direct manipulation. Indeed, when you look at applications that are available on both platforms, such as *Excel* or *PageMaker*, the differences start to seem almost nominal. But a real difference lies in the way the Macintosh operating system (the System) and its interface (the Finder) work together. The two add up to an environment that is truly object-oriented and is consequently more cohesive and easier to use than *Windows* 3.0.



Apple's Macintosh still beats *Windows* 3.0 when it comes to integration and ease of use.

IT'S ALL IN THE UNDERPINNINGS

The key lies in the way that the two rivals handle programs and files. In *Windows* 3.0, the Program Manager is primarily an interface for arranging and starting programs. Though you can associate data files with the applications that created them, this is a manual process. Most often, you use *Windows* 3.0 programs in the same way you use DOS programs: first you start the program, then you open the data file you want. And if you should want to manipulate or arrange the directories and files in your computer, you must use a separate program, the File Manager.

The Macintosh's Finder, by contrast, imposes no distinction between programs and files. Consequently, it both looks and works much more like a real desktop. In the Finder, you group both programs and data files into "file folders" that represent actual subdirectories on the disk. Since the Macintosh System automatically keeps track of which application created a data file, you can open any file simply by double-clicking on it; you don't have to associate it manually first. The System also lets you give data files meaningful names because it's not bound by the DOS file-naming restrictions, as is the *Windows* 3.0 environment.

The close linkage between the Mac file system and its user interface makes other niceties possible. For instance, to delete files, the Macintosh uses the straightforward concept of the trash can: you simply drag the icons of the files you don't want into the trash can icon. With *Windows* 3.0, you can delete an icon from the Program Manager, but the files are still there on the disk; to get rid of them, you must go into the File Manager. In place of a simple operation, you have a complex one that requires multiple steps and a fair amount of DOS knowledge to complete.

More important is the Macintosh System Folder, a special subdirectory in the Finder that contains the initialization files that are executed when you start up the Macintosh. To make changes to the system configuration, you simply add or remove files in the System Folder. Contrast this with *Windows* 3.0, where the configuration may be affected by as many as four different files (WIN.INI, SYSTEM.INI, AUTOEXEC.BAT, and CONFIG .SYS). Though you can make some changes through the *Windows* Setup and Control Panel utilities, often you'll need to resort to a text editor to edit the files. You'll also need some basic knowledge of programming techniques, since the syntax of these files is complex and options must be precisely specified.

THE REAL THING

PC users who want real Mac-like functionality do have other options at their disposal. Hewlett-Packard's *NewWave* environment, which is built on top of *Windows*, supplies the object-oriented features that *Windows* lacks. Its desktop is very similar to the object-oriented desktop of the Macintosh Finder. In fact, it even outdoes the Mac Finder in a number of ways, notably in its support for object-oriented compound documents that encapsulate the various programs used to create its different parts.

In the long term, OS/2 Presentation Manager will also offer a real choice to the Mac user. Though in its present form its user interface is almost identical to that of *Windows* 3.0, OS/2 has already acquired some of the fundamental facilities of the Mac System. In particular, its High-Performance File System (HPFS), inaugurated in Version 1.2, offers the foundation for a true object-oriented interface, with support for long filenames and extended attributes that let the system keep track of which application created which data file.

Still, it's important to keep things in perspective. *Windows* 3.0 and the Macintosh Finder have more similarities than differences. Now that both PCs and Macintoshes have similar graphical interfaces, more applications will be common to both platforms, and users will have an easier time operating both of them. Companies will be able to integrate PC and Mac systems more easily and effectively. ■

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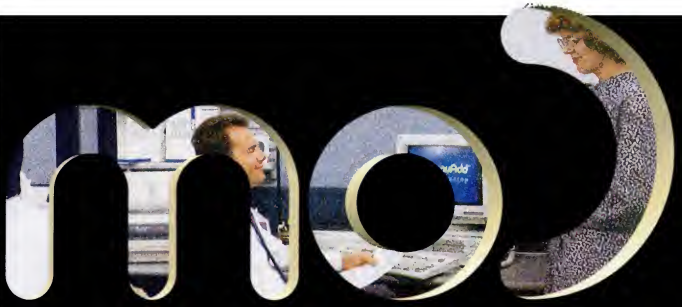

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2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

1. Follow instructions on the other side

Back

GbsSlipBack-001B

Inverted Back

1. Follow instructions on the other side

Is it the motherboard?

Look inside an IBM® PS/2 Model 70-386, a Compaq® Model 84-386 and a CompuAdd® system. See any visible differences? All three companies design and manufacture their own motherboards. They all use an Intel microprocessor and offer a number of available expansion slots (three on the IBM, six on the Compaq and five on the CompuAdd).

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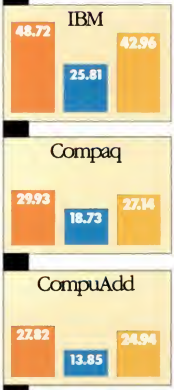
Is it performance?



We ran head-to-head benchmark tests' on these systems under three CPU-intensive applications: PageMaker, Magellan/1-2-3 and AutoCAD. While the results were no surprise to us, they might surprise you. Under PageMaker, CompuAdd performed 43% faster than IBM and 7% faster than Compaq. Running Magellan/1-2-3, CompuAdd was 46% faster than IBM and 26% faster than Compaq. And under power-hungry AutoCAD, CompuAdd outran IBM by 42% and edged Compaq by 8%.

(Completion time in seconds)

$

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The CompuAdd 425 is FCC Class A Approved. Not intended for residential use.

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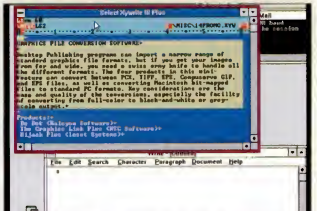
On 286 machines and on 386 machines with less than 2MB of RAM, *Windows* normally runs in standard, or 286 protected mode, which allows *Windows* programs to view all the memory installed in your machine as a single, segmented address space up to 16MB in size. This alone brings substantial performance benefits to all *Windows* applications because they needn't discard and reload memory segments so frequently. The extra memory space lets you fit multiple large applications into memory at once, speeding them up; it also allows developers to create complex programs that would never fit inside the 640K limit of real-mode operation. Standard mode supports the protection features of the 286 chip, which offers multiple tasks a degree of hardware-based protection from one another when running and helps prevent system-wide crashes.

Windows 3.0's 386 enhanced mode opens up the power of the 386 processor for multitasking DOS applications. Each DOS application gets its own 1MB virtual machine, under the control of the 386 processor. This makes it possible to run DOS applications in windows alongside *Windows* applications, as well as cut and paste text and graphics between them. it also lets you run standard communications software in the background.



TAPPING THE 386

Standard mode requires a 286 or 386 PC with at least 1MB of memory, of which at least 256K must be configured as extended memory. If you have a 386 machine and at least 2MB of RAM, *Windows* 3.0 can be run in 386 enhanced mode, which, while slower, offers a number of useful features. For one thing, 386 enhanced mode opens up more memory—as much as your 386 system will hold—for applications to use directly. It also supports the powerful virtual-memory paging feature of the 386 chip. This fast, hardware-controlled scheme allows temporarily unneeded memory contents to be written to the hard disk in small 4K pages, effectively making the hard disk a transparent addition to your physical memory. Finally, 386 enhanced mode supports the virtual 86 mode of the 386 processor, which lets you multitask standard DOS applications alongside *Windows* applications (see below).

For backward compatibility with unmodified *Windows* 2 programs, *Windows* 3.0 offers real mode, which you can specify by using the /R switch on the command line when starting *Windows*. In real mode, *Windows* 3.0 runs exclusively in conventional memory and uses both small-frame and large-frame expanded memory, just as its predecessor did. Though real mode offers a solid foundation for the transition period from *Windows* 2 to *Windows* 3.0 and makes *Windows* usable on machines with limited memory resources, the need for it will diminish as software developers introduce *Windows* 3.0–capable versions of their products.

> The ability to integrate DOS applications into your graphical desktop is one of *Microsoft Windows* 3.0's most valuable assets.

NO MORE TEARS

The inability to run smoothly with standard DOS applications has always been one of *Windows*' weakest points. Setting up .PIF files was a process fraught with complications; even when correctly done, using *Windows* in this way was all too often an act of faith. *Windows* was simply not able to handle all that the DOS world threw at it. Using *Windows* required committment, something not all users were willing or able to do.

Thankfully, the ability to integrate DOS applications into your graphical desktop is one of *Windows* 3.0's most valuable assets. When operating in standard mode, *Windows* 3.0 now runs DOS applications in full-screen mode, which leaves most of the machine and almost the entire 640K conventional memory space available to the DOS application. Consequently, there are fewer limitations on what kinds of programs can be run—and fewer things to go wrong—than in *Windows* 2.

In standard mode, you cannot multitask DOS applications. When you switch away from a DOS application, it gets swapped to disk and is held in a state of suspended animation until you switch back to it. Similarly, your *Windows* applications come to a stop when you're working with a DOS application. Still, the ability to use *Windows* to context-switch between DOS applications is a worthwhile benefit.

THE 386 ADVANTAGE

But *Windows* 3.0's true power isn't seen unless you're in 386 enhanced mode,

BOOSTING WINDOWS' PERFORMANCE

by Craig Stinson

In a world of unlimited resources, getting great performance out of *Windows* 3.0 would be no trick. You'd simply set up shop on a 33-MHz 386 with 16MB of extended memory and a huge, uncluttered hard disk. But in the real world, most of us must make efficient use of limited assets. Here are a dozen tips for getting the best out of what you've got.

1. BE REALISTIC.

Microsoft says the minimum requirements for *Windows* are a 286 with 1MB of RAM for standard mode or a 386 with 2MB for 386 enhanced mode. In practice, you'll find this inadequate for all but the smallest *Windows* applications. If you plan on using large programs like *PageMaker*, or if you want to be able to run several applications at once, you'll need more memory. Much more memory. Count on 2MB of RAM as a practical minimum for any *Windows* installation; if you plan to make real use of 386 enhanced mode, a 16-MHz 386SX with 4MB is more like it.

It doesn't pay to skimp on your hard disk or video card, either. Your *Windows* workstation should be equipped with at least a 40MB hard disk, and since *Windows* uses the hard disk quite heavily, especially when running in 386 enhanced mode, the faster the better. Likewise, a fast 16-bit VGA card is almost a necessity, as it makes resizing and moving windows smooth and hesitation-free.

2. USE EXTENDED MEMORY.

Applications written for *Windows* 3.0 can use every byte of extended memory you give them. The more you have, the more applications you'll be able to run at once—and the larger the documents you'll be able to create. Conversely, any expanded memory you allocate is that much less available to *Windows*.

In standard mode, retain only as much expanded memory as you need for specific DOS applications (for example, for those monster *1-2-3* spreadsheets). In 386 enhanced mode, make all your memory extended: *Windows* itself will emulate expanded memory when a DOS application asks for it. Control the amount of expanded memory allocated to a non-*Windows* application in the EMS section of the application's Program Information File (PIF).

3. DON'T WASTE MEMORY ON TSRS.

Though you can load TSRs before starting *Windows*, this wastes memory that could be put to good use by *Windows* itself. Since you can use *Windows* itself to switch between programs, you can treat pop-up programs such as calendars and phone dialers as ordinary non-*Windows* applications. If you use 386 enhanced mode, you can even assign a hotkey to each program. Alternatively, you can load all your TSRs in a single DOS partition; to call them up, switch to the partition and use the programs' normal hot keys.

4. USE A DISK CACHE.

Windows 3.0 makes intensive use of your hard disk. As you might expect, a disk cache can improve *Windows* performance dramatically. Though the latest versions of some third-party caches (such as Multisoft's *Super PC Kwik*) work with *Windows*, Microsoft's own SMARTDRV.SYS, which is installed automatically during *Windows* setup, will probably be your choice; it works cooperatively with *Windows*, expanding to its full size when memory is abundant and shrinking to a minimum when *Windows* needs more memory for its own purposes.

With SMARTDRV.SYS, you can specify a maximum and minimum cache size. These are determined by the *Windows* setup program, but you can tinker with them to improve performance at the expense of *Windows* memory. If you have 4MB or more of memory, try using 1,024K and 512K as the normal and minimum cache sizes, respectively. With 2MB of RAM, try 512K and 256K instead.

5. USE A PERMANENT SWAP FILE.

In 386 enhanced mode, *Windows* uses the virtual-memory paging features of the 386 chip to extend its effective memory resources by writing unneeded pieces of memory to the hard disk. By default, *Windows* creates its paging file as an ordinary DOS file, expanding it in 1MB increments as needed. However, if you can dedicate a large amount of disk space (4MB or more) to a permanent swap file, do so. You'll get better performance because this allows *Windows* to bypass normal DOS file functions and to write to contiguous sectors only. To set up a permanent swap file, start *Windows* in real mode (use the command win/r) and run SWAPFILE. *Windows* will prompt you for the information it needs.

6. GET RID OF DISK CLUTTER.

Windows requires quite a bit of free disk space to operate effectively. In standard mode, count on having at least 2MB for *Windows*, plus at least half a megabyte for the application swap file for each non-*Windows* program that you expect to use at a given time. In 386 enhanced mode, allow at least 2MB extra for the paging file; 4MB is better if you have the space. Add another couple of megabytes at least for the Print Manager's spool files, which can be huge.

If *Windows* ever crashes while you're working, it may leave temporary files on your hard disk. Don't let this space go to waste. To free it up, delete any files in your *Windows* directory having the extensions .TMP, .SPL, and .SWP, and use CHKDSK /F to find lost clusters *before* you start *Windows* (never do this while *Windows* is running!).

7. USE A DISK OPTIMIZER REGULARLY.

Regular use of a disk defragmentation utility, by shortening the times required to load and save files, will increase *Windows*' performance and also save wear and tear on your hard disk. Defragmentation also helps SMART-

CONTINUES

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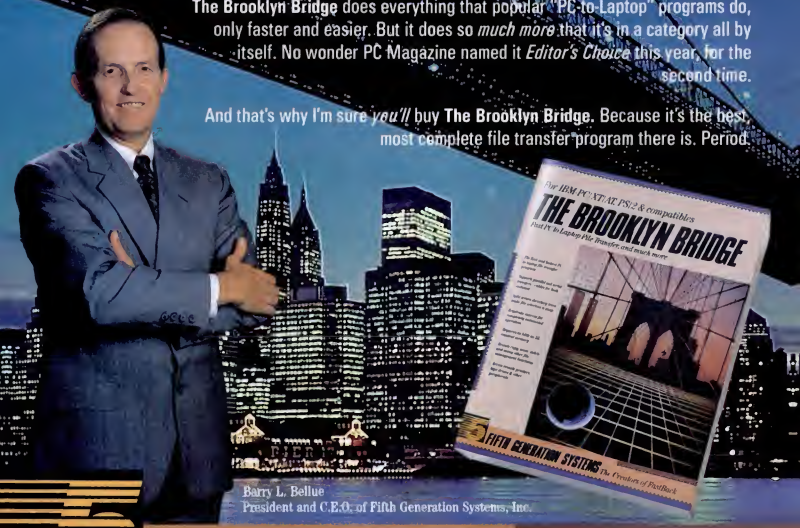

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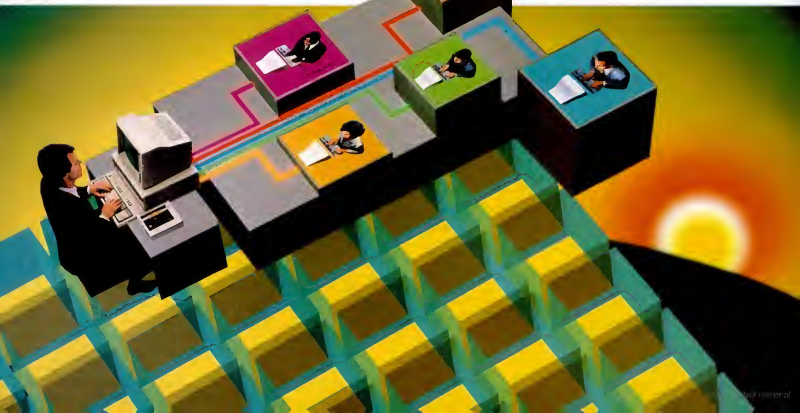


BOOSTING WINDOWS' PERFORMANCE CONTINUED

DRV.SYS to work better by putting the contiguous parts of your *Windows* files together where they can be read in a single pass. A disk optimizer is essential before you set up a permanent swap file in 386 enhanced mode because you'll need it to pack all the files into place and open up a large contiguous space for the swap file.

8. USE STANDARD MODE.
386 enhanced mode works with as little as 2MB of memory, but the overhead required for the extra code to support its additional features cuts fairly deeply into machine resources. Unless you really need virtual memory or the ability to run DOS applications in the background, you may prefer to use standard mode even on your 386, which leaves more memory to *Windows* applications and makes *Windows* itself run 5 to 10 percent faster.

9. USE A RAM DISK (MAYBE).
A RAM disk trades capacity for speed. You're not likely to find that tradeoff advantageous in *Windows* unless you have a great excess of memory over the amount you need to run your *Windows* applications. If you're in that fortunate position, however, you can speed the operation of these applications by using a RAM disk to store their temporary files.

To do this, install Microsoft's RAMDRIVE.SYS driver and reset the TEMP environment variable to the drive identifier of your RAM disk. All applications that use the TEMP variable will store their temporary files there, so make sure the latter is large enough to hold the files from all the applications you're likely to have open at once.

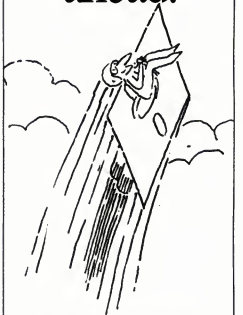
10. PUT CONFIG.SYS ON A DIET.
This advice can be important if you have limited memory. You can reclaim some memory from DOS by exercising restraint in configuration. Don't set your BUFFERS greater than 20; if you're using SMARTDRV.SYS, reduce them to 10. Don't set the number of FILES greater than 30 unless you use an application that requires a larger value, and don't set LASTDRIVE higher than the highest disk letter you actually use.

You should also take the opportunity to unload any unnecessary, memory-hungry device drivers. If you can get along without a mouse in your non-*Windows* applications, you can eliminate your mouse driver because *Windows* has its own. ANSI.SYS is another good candidate for the axe if you're short on memory.

11. USE PIF OPTIONS TO CONSERVE MEMORY.
The flexibility and power of 386 enhanced mode makes it all too easy to be profligate with scarce memory resources. Choose the settings in PIFs (Program Information Files) to conserve memory usage by DOS applications. Don't, for instance, specify 640 or -1 in the KB Desired box; experiment a bit to find out how much memory your program actually uses. Similarly, if your application doesn't use extended or expanded memory, don't allocate any to it. You can save a few extra kilobytes with some of the video and keyboard settings; see the section on PIFs in your *Windows* manual for more information.

12. DON'T RUN DOS APPLICATIONS IN THE BACKGROUND.
When setting up PIFs for non-*Windows* applications in 386 enhanced mode, it's best to leave the Background Check box unchecked—except for communications programs and other applications that always require background processing. This conserves a lot of memory and processing overhead that is better applied to *Windows* as a whole. If you occasionally need to run a DOS program in the background, you can open its Control menu on the fly (by pressing Alt-Spacebar), choose the Settings command, and then click the Background box. ■

Full speed ahead.



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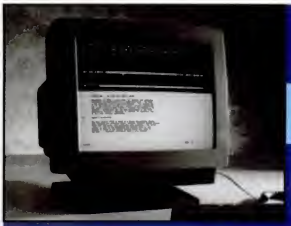

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which lets you take advantage of the virtual 86 mode of the 386 processor to multitask DOS applications alongside *Windows* itself. This powerful feature creates a protected "virtual machine" with its own 1MB address space for each DOS application. Because each program (including *Windows*) thinks it owns the machine, even ill-behaved DOS applications can coexist in relative harmony with each other and with *Windows*.

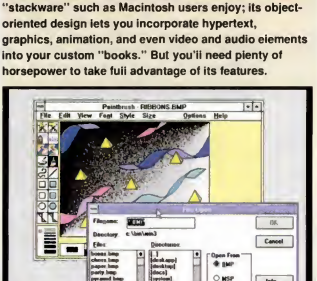
Since the job of switching from program to program is handled by the memory manager on the 386, it's quite fast; unlike standard mode, it's not necessary for *Windows* to read in the application swap file from the disk in order to change contexts. A nice extra benefit is that you can assign a hotkey to any application and use it to bring the application immediately to the foreground even if you're running another DOS application in full-screen mode at the time.

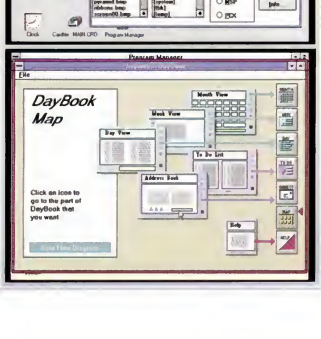
Virtual 86 mode also makes it possible for *Windows* to run any DOS application, whether text-mode or graphics-based, in a window. This can be useful for cutting and pasting text, but since windowing slows down screen performance a great deal, particularly with graphics, you'll probably prefer to use the applications in full-screen mode. If your goal is to multitask DOS applications, *Windows* 3.0 is no substitute for *DESQview 386*. While you can select foreground and background time slices for your DOS applications, *Windows* 3.0's options are less versatile (though also less complicated) than *DESQview*'s. In any case, *Windows* itself is still treated as a single task, and *Windows* applications are multitasked nonpreemptively, as they always have been.

With these improvements, setting up DOS applications is far easier than it was in *Windows* 2; for the most part, the default settings let you simply run DOS or your application from *Windows* 3.0. This makes PIF (Program Information Files), the ancient bane of the *Windows* 2 user, now mostly unnecessary, though they can be important for controlling background processing, video performance and memory usage, and handling potential keyboard conflicts.

The *Windows* accessories have been given a facelift for *Windows* 3.0. The Paintbrush accessory, in particular, is much improved: it can edit up to 256 colors and stores files in .PCX format as well as in *Windows* 3.0's proprietary bitmap (.BMP) format. You can apply any bitmap, such as the "Ribbons" pattern shown here, to the *Windows* desktop, which can also be decorated with repeating patterns.

Every copy of *Windows* 3.0 comes with a runtime version of *Toolbook*, a HyperCard-like custom application builder from Asymetrix that includes DayBook, a sharp-looking personal information manager. *Toolbook* opens the doors to the exchange of "stackware" such as Macintosh users enjoy; its object-oriented design lets you incorporate hypertext, graphics, animation, and even video and audio elements into your custom "books." But you'll need plenty of horsepower to take full advantage of its features.





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Microsoft Windows 3.0
Microsoft Corp.
One Microsoft Way, Redmond, WA 98052-6399; (800) 426-9400, (206) 882-8088.
List Price: $149.
Upgrade from previous version, $49 plus $5 shipping.
Requires: IBM AT, PS/2, or compatible. 1MB RAM (2MB recommended), hard disk, DOS 3.1 or later. 80386- or 80386SX-based PC and 2MB RAM required for 386 enhanced mode operation. EGA or VGA graphics adapter and mouse strongly recommended.
In Short: Though far from perfect, *Windows* 3.0 is a practical choice, offering a powerful graphical operating environment to millions of DOS PC users without forcing them to give up standard applications.

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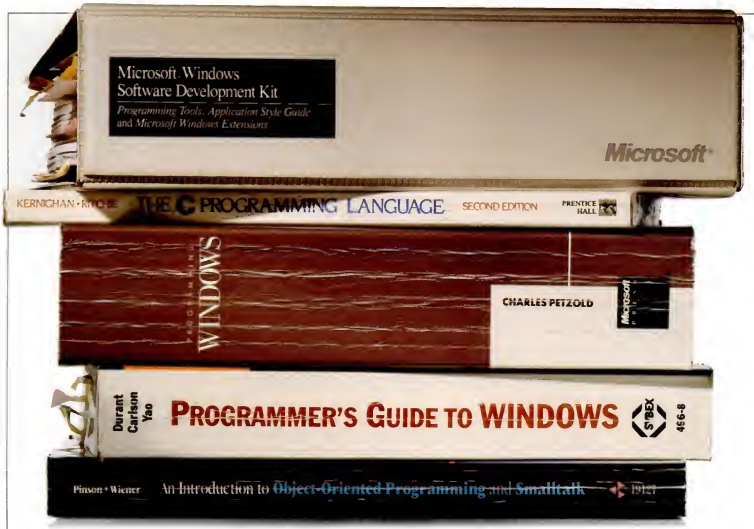
BETTER NETWORK SUPPORT

Windows has always coexisted with networks, but it never really cooperated with them. Until *Windows* 3.0, you had to log on to the network and map all your drives and printers before starting *Windows*. *Windows* 3.0 comes with network drivers so that you can perform these tasks from within *Windows*. Included in the package are drivers for Novell's *NetWare* 2.10 or 386, 3Com's *3+Share* and *3+Open*, Banyan's *VINES* 4.0, and IBM's *PC LAN* program, as well as generic drivers for Microsoft's own *MS-NET* and *LAN Manager*–based network software. Drivers for other network systems will almost certainly be made available as needs develop.

The *Windows* Setup utility detects your network during installation and installs the proper driver; you can also install a driver after the fact. Once the driver is installed, you can use the Control Panel to log on and off the network, attach and detach servers, and change your user ID and password. Print Manager passes along print jobs to the network print queues; with some networks you can even use it to check the status of the queues before submitting the job. And File Manager lets you log onto network drives individually as needed, avoiding the need to read in the



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listings for all the hundreds or thousands of files on a network server.

Windows 3.0 also makes it easier to install a shared copy of *Windows* to run from a network server. It is now configured to let you share the *Windows* program files while retaining custom user settings in a local hard disk or personal network directory. You can improve performance by putting application swap files or 386 enhanced mode paging files on a fast local hard disk; alternatively, you can run *Windows* on a diskless workstation by putting these files on the network server.

APPLICATIONS GALORE

For applications developers, *Windows* 3.0 means momentous opportunities. The provision of a full-fledged graphical environment for the PC, freed of the memory and performance limitations of previous versions, for the first time makes possible a new generation of bigger, smarter, more complex *Windows* applications. The variety of vendors that have shipped *Windows* 3.0 applications or announced the intention to create them makes it clear that we can expect an explosion of new and

WINDOWS 3.0 MAY BE NEAT . . . BUT OS/2 IS EVEN BETTER

by Charles Petzold

So now that *Windows* 3.0 has arrived, who needs OS/2 Presentation Manager, anyway? Anybody who's serious about the future of personal computing, that's who!

Now that it has breached the 640K barrier, *Windows* 3.0 can certainly be said to match or even exceed OS/2 1.2 in some capabilities. Yet while *Windows* 3.0 runs in protected mode, it still runs on top of DOS, which means you're stuck with the inherent fragility of real-mode software at the base of everything else. Almost everyone who uses RAM-resident programs knows how fragile DOS software can be, and the same still goes for *Windows* 3.0. If a *Windows* 3.0 program running in protected mode passes a bad pointer to a DOS function call, DOS and *Windows* can come crashing down together.

A BETTER KERNEL

The OS/2 kernel is designed to be much more robust. Passing a bad pointer to an OS/2 kernel function simply terminates the particular program gracefully rather than causing the entire operating system to crash. Moreover, OS/2 has several important features not available in DOS or *Windows* 3.0 that make it a sturdier foundation for powerful, complex applications.

First, OS/2 gives you an alternative to the slow and antiquated DOS file system, which was originally designed for floppy diskettes. The High Performance File System (HPFS) included in OS/2 1.2 is not just faster than the old FAT (file allocation table) system: it also supports truly descriptive filenames that can be up to 256 characters long and offers free-form extended file attributes that help applications exert better control over the use of files. HPFS lays the foundation for a truly object-oriented file system.

Second, though *Windows* 3.0 can indeed run multiple *Windows* applications at the same time, the multitasking that it implements is nonpreemptive. Consequently, *Windows* programs must be carefully written to yield control to *Windows* frequently when performing lengthy operations. OS/2's support for preemptive multitasking allows PM programs to be structured more cleanly and efficiently; it also lets them split themselves into multiple threads of execution that truly do run concurrently.

This last capability is particularly important in a graphical interface because it lets the programmer shift operations that take more than a few seconds to the background. When used properly, multithreading almost completely prevents the appearance of the dreaded hourglass icon, making it possible for users to execute lengthy tasks while still being able to interact with the program. To see the advantage of this, you need only look at Aldus's *PageMaker* for the OS/2 Presentation Manager. The improved performance it offers over the Macintosh and *Windows* versions of the program is immediately noticeable.

Finally, the facilities that OS/2 offers for communication between running programs are more varied and robust. Its queues, semaphores, and named pipes are unmatched in *Windows* 3.0.

GRAPHICS SUPPORT

Windows 3.0 and the OS/2 Presentation Manager look almost identical on the surface, yet underneath they are quite different. The application program interface (API) of OS/2 is similar in overall structure to that of *Windows* but is far different in detail.

The *Windows* Graphics Device Interface (GDI) and the OS/2 Graphics Programming Interface (GPI) are comparable in some rudimentary capabilities, but OS/2's GPI has several features that go far beyond *Windows* GDI. These features include vector-based fonts, support for a greater variety of curved lines (including Bezier splines), a hierarchy of coordinate spaces with matrix transformations between them, and nonrectangular clipping. GPI also offers PostScript-style paths that are useful for filling, clipping, or thick stroking, and a selection of line ends and joins.

Presentation Manager's GPI gives OS/2 programmers better tools for implementing high-performance graphical applications than *Windows* programmers enjoy. And while some of these features can be emulated under *Windows* GDI, they will often suffer performance penalities. This will be especially true with high-performance video boards based on graphics coprocessors. The architecture of OS/2's GPI allows an intelligent video board with its own coprocessor to directly execute any graphical operation of which it is capable. These graphical operations must be emulated under *Windows*, which is necessarily slower.

THE 32-BIT FUTURE

Windows 3.0 currently has two technical advantages over OS/2, both of which require a 386 microprocessor. First, *Windows* 3.0 takes advantage of the 386 paging registers to implement

significant *Windows* software in the next several months.

The most notable candidates will be major Macintosh programs that can now be ported over to the PC under *Windows* 3.0. Microsoft itself has already brought *Powerpoint,* its high-end presentation graphics program over to *Windows* 3.0, and the addition of *Persuasion* from Aldus, *Powerpoint*'s chief competitor on the Macintosh, will soon revolutionize a field dominated on the PC by text-based solutions. *PageMaker* 4.0, already out on the Macintosh, will rely on the increased headroom that *Windows* 3.0 offers, as does the upcoming *Windows* version of *Ventura Publisher*.

Down the road, we can expect to see a

virtual memory, whereas OS/2's virtual memory is based on the less-efficient segmented scheme supported by the 286 processor. Secondly, *Windows* 3.0 uses the Virtual 86 mode of the 386 microprocessor to multitask DOS applications. OS/2 is currently bound by the limitations of the 286 for which it was designed. Its DOS Compatibility Box supports only one DOS session at a time, and this session is suspended when an OS/2 session is active.

But OS/2 will pick up these two features and go well beyond them with its next release. OS/2, Version 2.0, is currently in beta testing and should be released to the world early next year.

OS/2 2.0 is the first version that will run directly in 386 protected mode and take advantage of its linear 32-bit address space. This is a major and necessary advance, not least because it will finally get rid of the 64K segments that have plagued PC programmers over the past decade. OS/2 2.0 is also designed to be portable to hardware platforms other than the Intel-based PC line, particularly RISC machines. Again, this is an important strategic consideration for the future. Microprocessor technology is advancing too quickly for an operating system platform to be bound to a single microprocessor family.

Microsoft has publicly stated that *Windows* will never support a 32-bit linear architecture. In addition, it is highly unlikely that *Windows* will ever run on anything except Intel processors. The *Windows* API is too closely tied to Intel's 16-bit segmented architecture for this to happen without requiring major changes to existing *Windows* applications.

Because it takes advantage of the 386, OS/2 2.0 will run 16-bit OS/2 programs, multiple DOS sessions, and even unmodified *Windows* 3.0 programs concurrently with newly written 32-bit OS/2 programs. In short, OS/2 2.0 will at last give you everything that DOS and *Windows* gives you now, while providing a solid base for more sophisticated applications in the future.

A FEASIBILITY STUDY

At its heart, *Windows* is still a feasibility study. Over the nearly five years of its retail existence, it has been significantly improved and enhanced, and, unlike OS/2, it has had sufficient time to support devices and applications that appeal to a broad base of users. With *Windows* 3.0, it has reached critical mass. It is now a real alternative to DOS, not just an enhancement of it.

Yet *Windows* remains a dead end for the long term. No matter how much it may be improved, it will forever be DOS software, and it will forever be 16-bit segmented software. So it will never be able to take full advantage of future hardware developments. It is certainly an important piece of system software. But it so primarily because it will be the first graphical interface that millions of DOS users will encounter.

It will not be the last. Today most users will choose *Windows* 3.0, but OS/2 Presentation Manager will be the strategic environment that will carry PC users into the next century. Sure, it has more rough edges than *Windows* and offers significantly fewer applications. But that is more a result of *Windows*' three-year head start than anything else.

Where will OS/2 be in three years? Probably on your desktop. ■

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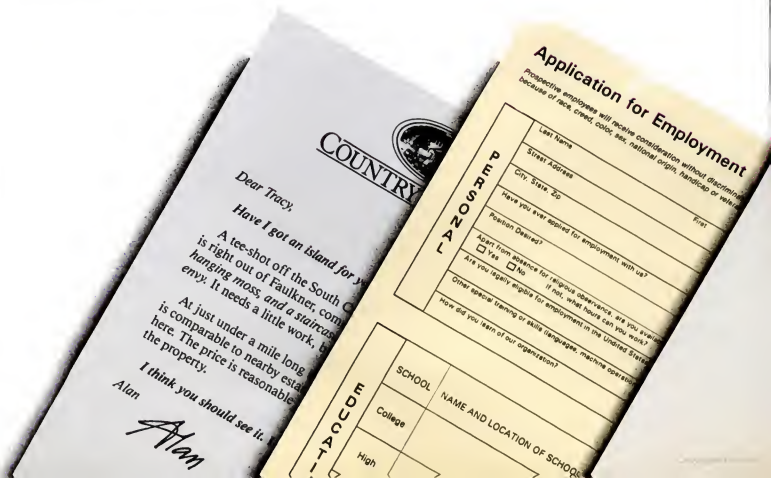

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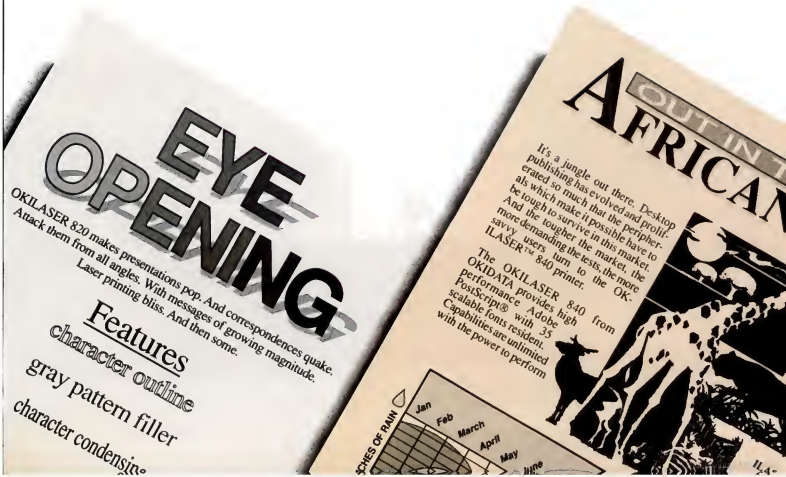
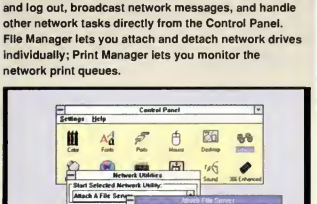


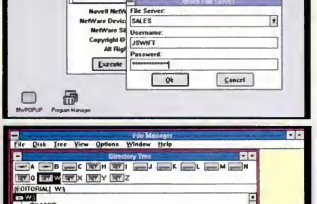
Windows version of Macromind *Director*, a sophisticated set of multimedia presentation tools. And something like HyperCard has come to *Windows* with Asymetrix's *Toolbook* and Spinnaker's *Plus*, offering nearly unlimited possibilities for customized personal applications featuring graphics, sound, and animation. (Indeed, a runtime version of *Toolbook* is included in every *Windows* 3.0 package). With all these options, the PC will be much more competitive with the Macintosh on the latter's own turf.

Windows 3.0 makes new PC products possible as well. Microsoft's *Project* and Delrina Technologies' *PerForm* are just two of the sophisticated packages that rely on *Windows* 3.0's improved environment to do things that would be impossible or impractical under *Windows* 2. We can expect more of these in the future, along with improved versions of existing *Windows* programs (such as *Word for Windows* and *Excel*) that will extend well beyond the versions available today. With user demand for *Windows* running high, even Microsoft's biggest rivals—Borland, Lotus, Ashton-Tate, and WordPerfect—are jumping into the act. *Windows* 3.0 versions of *Quattro Pro, Paradox, Lotus 1-2-3, WordPerfect, Multimate,* and *dBASE,* among others, should be here by early next year.

Finally, *Windows* 3.0 opens up doors for Hewlett-Packard's *NewWave* environment, which implements compound documents in a true object-oriented desktop. The *Windows* 3.0 version of *NewWave* is the first version of this exciting new technology that fully implements its Agents, which let you execute processes across multiple applications. Improved memory management has actually cut *NewWave*'s memory requirements from 4MB to 3MB.

Network users will be pleased that *Windows* 3.0 accommodates their special needs. Using special drivers for the major types of network software, *Windows* 3.0 lets you attach and detach servers, log in and log out, broadcast network messages, and handle other network tasks directly from the Control Panel. File Manager lets you attach and detach network drives individually; Print Manager lets you monitor the network print queues.





DEVELOPER ASSISTANCE

Though programming for a graphical environment is always a complex job, *Windows* 3.0 does make some things easier for developers. The use of protected-mode memory unshackles them from the limitations of bank-switched expanded memory, simplifies debugging, and makes meticulous performance tuning less important; it also improves the performance of DDE operations. The new Multiple Document Interface offers richer support for user interfaces, including pop-up as well as pull-down menus and the ability to iconize document windows within main application windows. Since Microsoft supplies an API for the *Windows* 3.0 help system, any *Windows* program can give on-line assistance to the user in a uniform way.

On the other hand, the new look of *Windows* 3.0 makes the design of certain items, such as dialog boxes, more difficult. Hopefully, the software development tools supplied by Microsoft and other vendors will keep pace with these additional needs. It is far too time-consuming to create such complex user interfaces from scratch, and the tools supplied with previous *Windows* software development kits have had some major deficiencies.

Windows 3.0's color palette manager ensures a consistent programming interface between _Windows_ and color devices.

COLOR IT LOGICAL

Windows 3.0's new color palette manager is of the greatest importance in presentation graphics, desktop publishing, and other applications that depend on color. This feature ensures a consistent programming interface between *Windows* and color devices, allowing *Windows* applications to use color without substantially interfering with the on-screen colors displayed by other applications.

Since the screen is shared by all running applications, changes made by a program to the palette registers on the graphics adapter affect not only the application's workspace, but the entire screen. *Windows* 3.0 gets around this effect by offering a device-independent method of addressing the screen that relies on one or more logical palettes, each of which specifies the colors to be drawn in a device context. When the application draws, it does not specify a color explicitly but instead uses the logical palette entries. The *Windows* screen driver then takes care of matching the requested colors with the colors in the system palette, which actually controls the screen display. The palette manager always satisfies the re-

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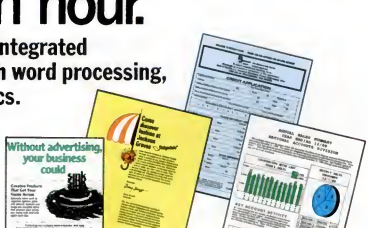

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THE INTELLIGENT WINDOWS DESKTOP: Making Program Manager Work For You

by Craig Stinson

By default, *Windows* 3.0 divides your programs into *Windows* and Non-*Windows* Applications, plus three groups for *Windows* utilities and accessories. Though this setup is eminently usable for many people, it may not suit your needs. Happily, the Program Manager is highly customizable, so you're not wedded to Microsoft's arrangement unless you want to be. Depending on the way you work, you may want to investigate some alternatives.

ORGANIZATIONAL SCHEMES

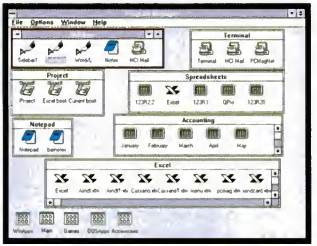
The key to organizing your work lies in program groups. Though the default desktop gives you separate groups for *Windows* and non-*Windows* applications, Program Manager lets you create as many groups as you need, and you can keep any program in one or all of them. This flexibility lets you group files according to your own needs.

For example, say you do most of your work using three application programs—the *Windows*-based word processor *Ami Professional*, the *Windows* database manager *Superbase 4*, and old reliable *Lotus 1-2-3*, Release 2.2. You might prefer to have all the data files you're working on from each program in the same place, just as you'd keep them in separate subdirectories under DOS. If so, you can create a program group for each of the three applications by selecting New from the Program Manager menu, then selecting the Program Group option.

Alternatively, you might prefer to set up your program groups by project instead. For example, suppose you're working on two large *PageMaker* publications, each of which involves several data files and requires the use of your favorite word processor, a drawing program, and a clip-art library in addition to *PageMaker*. If so, you can make your life easier by setting up a program group for each project, containing all the applications you need for that project.

LINKING FILES TO PROGRAMS

Now you have groups, but what about the files? When you're setting up an icon, you can attach any data file to the program you've used to create and edit that data file just by specifying its filename on the command line. You can then start an application and load the data file simply by double-clicking on the icon.



Customized program groups let you tailor *Windows* 3.0's Program Manager to work the way you work. Whatever your style, it's an able companion.

You might create your document icons from scratch, but there's an easier way: hold down the Ctrl key, select the application you want to use, then drag it into the group window you want to put it in. *Windows* 3.0 will make a copy of it for you.

You can then add the name of the file to the command line by using the Properties command on the File menu. All *Windows* applications and many DOS applications accept the name of a file on the command line in this way (in *1-2-3*, use the -w switch to specify the file to load after startup). At the same time, you change the name of the icon to something more descriptive, up to 40 characters long—say, "Budget Worksheet 1Q 1990."

Repeat this process for each document you want to include in the group, and all your documents will be laid out before you, just a mouse-click away. When you're through working with a file, just click on its icon and press the Del key to get rid of it. It's out of sight, but not out of reach; the underlying file is still there on your hard disk, ready to be recalled if you ever need to work with it again.

TIDINESS TIPS

The contents of the Program Manager's Window menu are very handy when you have a lot of program groups. The Cascade command stacks all your open group windows like a fanned hand of cards. The Tile command makes your desktop look like a kitchen counter, with each window flush against its neighbors. To keep your desktop tidy, minimize any groups that you don't immediately need; it's easy to call back a minimized group either by clicking on its icon (similar to the way you switch to a minimized application), or by selecting it from the Window menu.

With all this manipulation, you may find your icons getting out of line from time to time. Use the Arrange Icons command to set your icons back into neat, evenly spaced rows. If your icon labels often overlap, you can use the Control Panel to increase the space between icons: double-click on the Desktop icon, and increase the number in the box labeled Icon Spacing.

If you like everything neat and logical, Program Manager will accommodate you. If, on the other hand, you think a tidy desktop is a symptom of mental infirmity, Program Manager will support that point of view, too. In either case, you can rearrange your desktop as often as you like. Master its tricks, and you'll find it an able companion. ■

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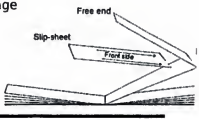

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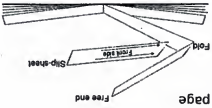

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quests of the foreground window first to ensure that the active application will have the best color display. It then matches the inactive applications as bet it can.

In addition to the stanlard 16-color EGA and VGA drivers, Mcrosoft also supplies a 640 by 480 by 256color driver for the Video Seven series of igh-resolution VGA graphics cards mnufactured by Headland Technology. If yo have one of these cards installed in you PC, you can now display a much wide range of colors without dithering—a fe considerably important in presentatiographics programs and other applicationhat produce color output.

Though high-resolution drivs have always been available for *Winows*, including this driver in the *Window*3.0 box sets a compatibility standard r third parties to meet; hence it should make 256-color screen displays a more practical and reliable option for many people. Headland, which wrote the driver in collaboration with Microsoft's *Windows* 3.0 development team, says that its driver code will be incorporated into Microsoft's Device Driver Development kit for other graphics board vendors to use.

Other important facilities should show up in *Windows* in the next year or so. Microsoft says the next version of *Windows* will have multimedia extensions that will endow the system software with facilities for handling high-quality sound from CD-ROM XA disks. Microsoft's new TrueType scalable font technology, which will give *Windows* (and Apple's Macintosh) many of the same advantages of Display PostScript and should finally make true WYSIWYG displays possible, may well be incorporated into the same release.

HEAD TO HEAD?

With all this power, it is reasonable to wonder if *Windows* 3.0 will steal the fire from the OS/2 Presentation Manager. After all, *Windows* 3.0 breaks the 640K barrier, offers an advanced graphical user interface with expanded color support, and in the future will offer scalable font technology, just like Presentation Manager. In fact, *Windows* 3.0's 386 enhanced mode offers page-mode virtual memory and DOS application support that OS/2, being a 286-based operating system, can't yet match. OS/2 has heftier RAM and disk

PUTTING WINDOWS THROUGH ITS PACES

By Brian Carr and Pamela Livinton

PC Labs approached the coing of *Windows* 3.0 with some skeism. We'd heard the hype, seen tUI, used it in beta. When the finode came, however, we wanted tow what exactly was going on behthe pretty icons—and whether it uld cost anything in terms of perfore. Specifically, we asked, what erence does the shift to protectede make to applications? Is font hang slower? What about the graphics s? How much of a performance hit du pay when you use the *Windows*-color driver?

To address the question of mem management, we created new bemarks to measure the performanc round-trip message loops, a comm task-to-task communication func in which a message is sent to a rec ing task that immediately respond the request. We developed three v sions of this test, each of which cor sponds to a different type of real-l scenario.

The first version, the Local Me sage Loop test, sends messages b tween two tasks within the same appl cation. A good example in real li would be a *Windows* application doin a background processing task, such a intelligent recalculation in a spread sheet. The second version, the Small Message Loop test, simulates the sending of messages between two small applications each under 100K in size, as in a text editor sending output to a print server through a communications port or network card. The third version, the Large Message Loop test, sends messages between two large applications each over 200K in size, such as you'd find linking two full-sized programs using Dynamic Data Exchange (DDE).

To give an idea of *Windows* 3.0's performance in today's applications, we supplemented these benchmarks with the Link Refresh test from our latest spreadsheet performance tests. We used *Microsoft Excel* under all environments.

We also tested the fundamental graphics and text functions of each environment using an updated version (1.2) of our graphics performance tests. In addition, we ran the same tests to compare the performance of the new 256-color driver for Video Seven cards with the standard 16-color driver.

Finally, we developed a test to measure the amount of real memory available to an application under a given operating environment. The Memory Buffer test continously allocates and accesses memory buffers until the environment is forced to write to disk or fail, emulating the effect of a large data file in a sizeable application such as *Microsoft Excel*. Since you can expect significant performance reductions once the data file no longer fits in memory, the more memory space you have, the better you'll do with large data files.

PLATFORMS

Since *Windows* 3.0 offers modes adapted to both the 286 and the 386, we ran the tests on both platforms. For the 286 platform, we used an 8-MHz IBM PC AT equipped with 4MB of RAM and a Paradise VGA 1024 graphics board. We tested *Windows* 3.0 in real mode and standard (286 protected) mode against *Windows* 2.03 and *Windows* 2.11 (*Windows* 386), as well as against OS/2 Presentation Manager (Standard Edition, Version 1.2). For the 386 platform, we used an IBM PS/2 Model 70 with 4MB of RAM and tested all of these, plus *Windows* 3.0 in 386 enhanced mode.

For the Link Refresh test, we used *Microsoft Excel* 2.1C for all versions of *Windows*, and *Excel* 2.2 for Presentation Manager. In our tests of the 256-color driver, we used a 20-MHz Compaq Deskpro 386, an ISA-bus machine in which we could install the Headland Technology Video Seven VRAM graphics adapter with which the driver is designed to work. ■

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PERFORMANCE TESTS: MICROSOFT WINDOWS 3.0

This newly written PC Labs test suite evaluates an environment's memory management under different conditions. The results highlight the performance advantages of protected-mode operation over bank-switched expanded memory in communications between applications.

The **Local Message Loop** test measures the time it takes to complete a round-trip message loop from task to task within a single application. (In a round-trip message loop, a message goes to the receiving task and a return message comes back to the sender.)

The **Small Message Loop** test simulates two small applications (each under 100K in size) communicating via a round-trip message loop.

The **Large Message Loop** test simulates two large applications (both larger than 200K) communicating via a round-trip message loop.

We also ran the **Link Refresh** test from our spreadsheet performance test suite using *Microsoft Excel* in all environments to see if any performance differences became evident in this fairly complex real-world task. In the test, 5 columns by 200 rows of a worksheet are linked to the corresponding cells in an external reference worksheet. We measured the time it took to refresh the links completely.

CONTINUES

appetites (though *Windows* 3.0 is not frugal in these matters, either). Above all, it suffers from the lack of software, printer, and device support that comes from being in a state of rapid change.

Yet OS/2 still offers notable technical advantages (see the sidebar "Windows 3.0 May be Neat . . . But OS/2 Is Even Better"), and there is good reason to believe in IBM and Microsoft's assertions that OS/2 will be the strategic operating environment for critical systems of tomorrow. Moreover, the success of *Windows* 3.0 in the next year will enhance, not detract from, the success of OS/2 in the future. The big move is from the character-based to the graphically based environment. Developers will find that with some care, they can leverage what they know about and what they have written for one environment into the other. And users will be able to take advantage of

MESSAGE LOOP AND LINK REFRESH TESTS

PC LABS

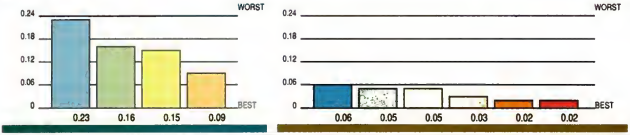
MESSAGE LOOP TESTS

286 Platform:
8-MHz IBM PC AT

386 Platform:
25-MHz IBM PS/2 Model 70

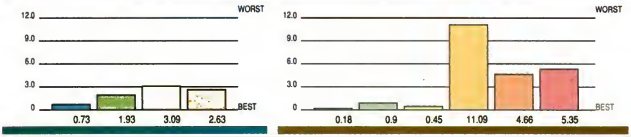
Local Message Loop

Elapsed Time (milliseconds)



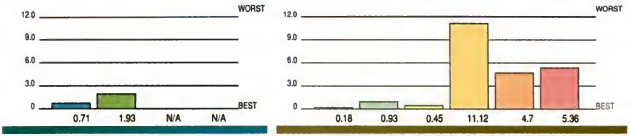
Small Message Loop

Elapsed Time (milliseconds)



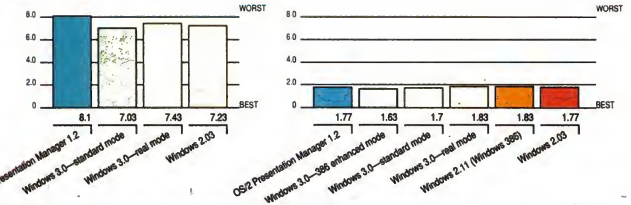
Large Message Loop

Elapsed Time (milliseconds)



Link Refresh

Elapsed Time (seconds)



N/A—Not applicable: the environment could not run the tests in expanded memory.

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WINDOWS 3.0 PERFORMANCE TESTS: COMPOSITE VIEW

Memory—and how it's used—is a prime consideration in the performance of any application. That's why we evaluated *Microsoft Windows* 3.0's various operating modes against *Windows 286*, *Windows 386*, and Presentation Manager on both 286 and 386 platforms.

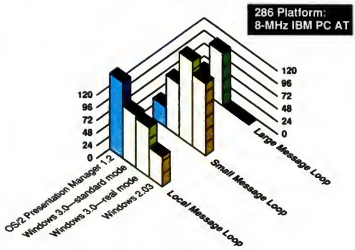
The results of our Message Loop tests show clearly where *Windows* 3.0's ability to access protected-mode memory matters most: in task-to-task communications. In our Local Message Loop test, which simulates an application talking to itself, *Windows* 2.x and *Windows* 3.0 running in real mode gave better results. Since the test did not exceed the bounds of conventional memory, the real-mode environments did not incur a performance hit due to bank switching of expanded memory. But *Windows* 3.0's protected operating modes were slowed by the extra overhead imposed by the checking of access privileges.

With the Small and Large Message Loop tests, however, the differences become apparent. When real-mode *Windows* has to manage two applications that won't fit at the same time into conventional memory, its performance degrades severely in comparison with *Windows* 3.0's protected modes, which benefit greatly from the large, uninterrupted address space that protected mode allows.

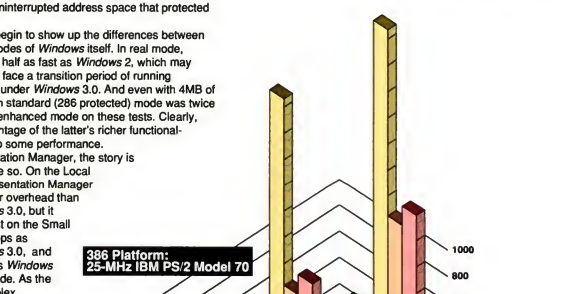
These results also begin to show up the differences between the various operating modes of *Windows* itself. In real mode, *Windows* 3.0 was about half as fast as *Windows* 2, which may make a difference if you face a transition period of running *Windows* 2 applications under *Windows* 3.0. And even with 4MB of memory, *Windows* 3.0 in standard (286 protected) mode was twice as fast as it was in 386 enhanced mode on these tests. Clearly, if you want to take advantage of the latter's richer functionality, you'll have to give up some performance.

As for OS/2 Presentation Manager, the story is the same, but even more so. On the Local Message Loop test, Presentation Manager imposes an even greater overhead than standard-mode *Windows* 3.0, but it proved over twice as fast on the Small and Large Message Loops as standard-mode *Windows* 3.0, and over five times as fast as *Windows* 3.0 in 386 enhanced mode. As the future brings more complex applications, Presentation Manager's performance edge will become more and more important.

Yet in the short term at least, you may not see much of a difference in your favorite applications. *Microsoft Excel*'s performance on our Link Refresh test, for instance, varied little between environments, though it's interesting to note that *Windows* 3.0 in 386 enhanced mode was slightly faster than its competitors. Evidently, *Excel*'s linking algorithms, for the most part, run independently of their environment.



Relative Times
(Windows 3.0 standard mode = 100)



Relative Times
(Windows 3.0 standard mode = 100)

ENDS

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It is not known whether the shocking loss was a result of natural aging while DOS made the backup, or whether the victim pulled his hair out in frustration after discovering that a minor disk error had rendered his entire backup set useless.
According to reliable sources, the tragedy could have been averted if the man had been using FASTBACK PLUS, the world's fastest and most reliable backup software.
A special commission has been appointed to study ways in which the public can be made aware that FASTBACK PLUS' Advanced Error Correction, easy-to-use menu, flexible file and directory selection, automated backup options and other features allow even beginners to make fast, foolproof backups.
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**The figures don't come from us. They're from a 1990 study conducted by Diagnostic Research, Inc., among* Fortune *1000 MIS managers and business computer users. Call and we'll send you a copy.*

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try the only one that actually works that way.

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CIRCLE 251 ON READER SERVICE CARD

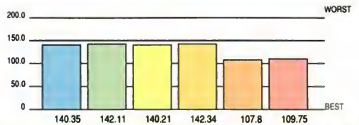
GRAPHICS PERFORMANCE TESTS: ENVIRONMENTS

This PC Labs test suite shows how well the environments perform on common graphics and windowing operations. Additional tests were run to test the difference in screen performance between Microsoft's new 256-color driver for Video Seven boards and the standard 16-color VGA drivers on the same platform.

286 Platform: 8-MHz IBM PC AT | 386 Platform: 25-MHz IBM PS/2 Model 70

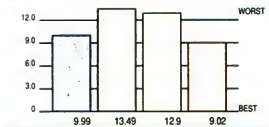
BitBlt Alignment

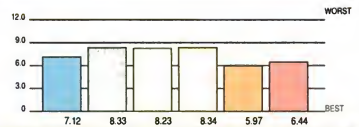
Elapsed Time (milliseconds)



Random Rectangles

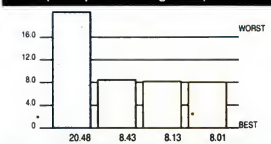
Elapsed Time (milliseconds)

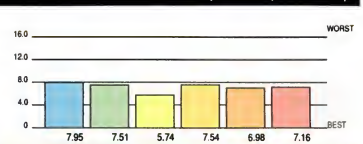




Text (Transparent Background)

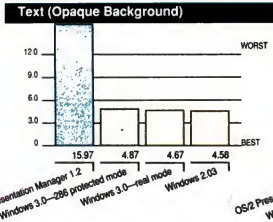
Elapsed Time (milliseconds)

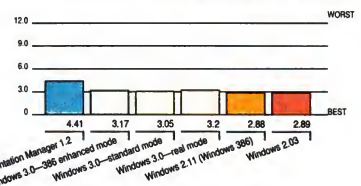




Text (Opaque Background)

Elapsed Time (milliseconds)





The **BitBlt Alignment** test uses the environment's bit-to-block transfer functions to move a square block of pixels rapidly from one location to another. We report the results for BitBlts configured as 256 by 256 pixels, using the Source Not Aligned and Destination Not Aligned options for all of these tests. This is the worst-case scenario, since it means that the bits describing each row of the bitmap do not begin on an 8-bit boundary (the start of a byte).

The **Random Rectangles** test draws randomly sized rectangles in random colors.

The **Text (Transparent Background)** test writes text to the screen using the standard system font and leaves the background untouched. The **Text (Opaque Background)** test does the same thing but fills in the background around the text.

The **Dialog Boxes (Show and Destroy)** test generates and erases a dialog box 20 times.

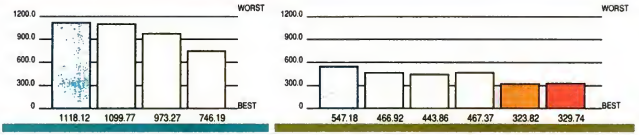
The **Scroll Window (Byte Alignment)** test scrolls aligned text vertically through a rectangular window. The **Scroll Window (Not Aligned)** test does the same thing with unaligned text.

The **Rectangular Clipping (Lines)** test creates four separate equal, rectangular windows on the screen with space between them, then clips to them a full-screen image composed of solid lines.

286 Platform: 8-MHz IBM PC AT | **386 Platform: 25-MHz IBM PS/2 Model 70**

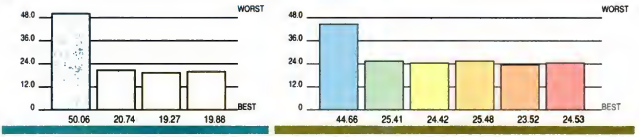
Dialog Boxes (Show and Destroy)

Elapsed Time (milliseconds)



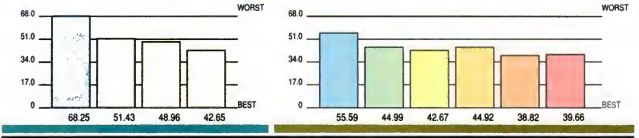
Scroll Window (Byte Alignment)

Elapsed Time (milliseconds)



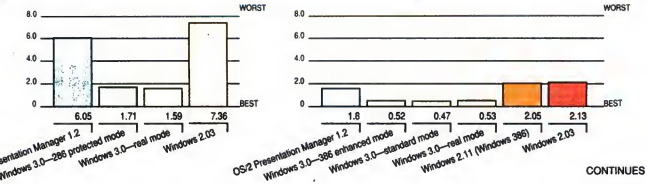
Scroll Window (Not Aligned)

Elapsed Time (milliseconds)



Rectangular Clipping (Lines)

Elapsed Time (milliseconds)



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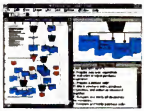

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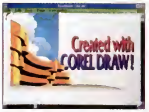

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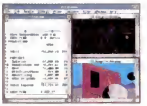

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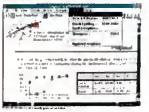

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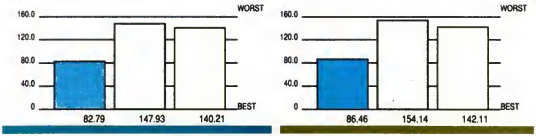
GRAPHICS PERFORMANCE TESTS: WINDOWS 3.0 256-COLOR VGA DRIVER

Platform: 20-MHz Compaq Deskpro with Video Seven VRAM Card

Windows 3.0 Standard Mode | Windows 3.0 Enhanced Mode

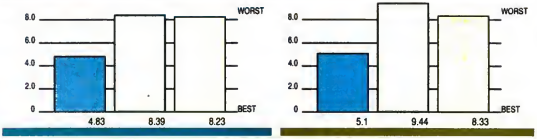
BitBlt Alignment

Elapsed Time (milliseconds)



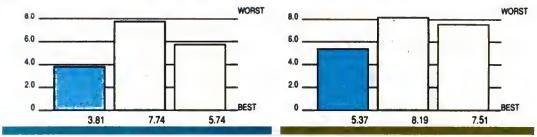
Random Rectangles

Elapsed Time (milliseconds)



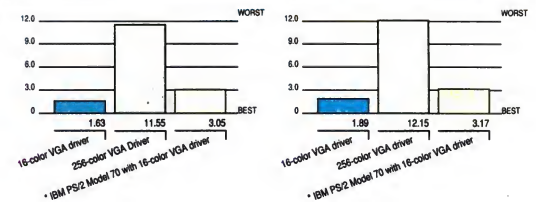
Text (Transparent Background)

Elapsed Time (milliseconds)



Text (Opaque Background)

Elapsed Time (milliseconds)



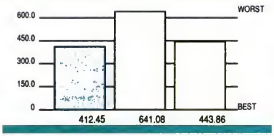
* Reported for comparison.

Platform: 20-MHz Compaq Deskpro with Video Seven VRAM Card

Windows 3.0 Standard Mode | **Windows 3.0 Enhanced Mode**

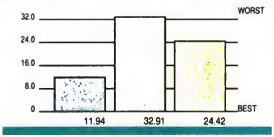
Dialog Boxes (Show and Destroy)

Elapsed Time (milliseconds)



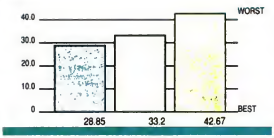
Scroll Window (Byte Alignment)

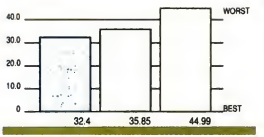
Elapsed Time (milliseconds)



Scroll Window (Not Aligned)

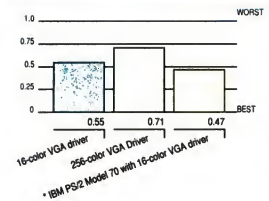
Elapsed Time (milliseconds)

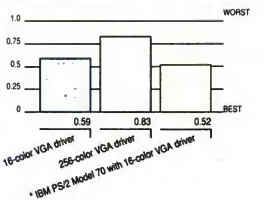




Rectangular Clipping (Lines)

Elapsed Time (milliseconds)





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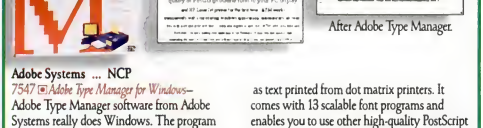

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7380 ⊞P.D. Queue 1.0 *(print spooler)* ... 55.
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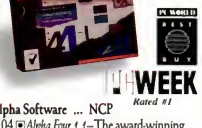

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5653 □1-2-3 2.2 . . . . . 349.
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Microsoft ... NCP
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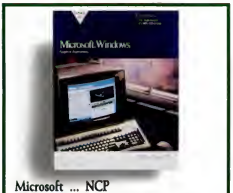
7388 ⊞Project for Windows 1.0 . . . . . 469.



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3221 □Expanded Memory Mgr. 386 5.1 . 59.
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6572 ⊞WealthBuilder 1.1 . . . . . 145.

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5799 ⊞Ami Professional 1.2 . . . . . 309.
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3496 □Professional Write 2.2. . . . . 165.
3482 □Harvard Graphics 2.3 . . . . . 339.
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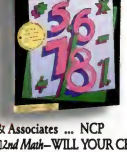

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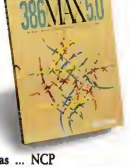

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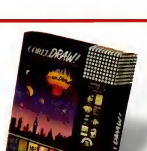
Manufacturer's standard limited warranty period for items shown is listed after each company name. Some products in their line may have different warranty periods.



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5788 HL-8Ps PostScript Laser Printer . 2949.
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7340 Flight Stick ..... 49.
7345 Rollermouse *(Trackball) serial* 85. *bus* 99.
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6765 LQ-1010 *(136 col., 180 cps, 24 pin)* call
1917 LQ-1050 *(136 col., 264 cps, 24 pin)* call
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3103 2400 Baud Internal Modem ..... 135.
3102 2400 Baud External Modem ..... 179.
5286 2400 Baud Int. MNP Modem *(Lev. 5)* 175.
5285 2400 Baud Ext. MNP Modem *(Lev. 5)* 209.
4542 2400 Baud Internal Modem for PS/2. 229.
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7127 Private Eye *(virtual display)* ..... 499.
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4562 Safe 425W *(standby power bkup)* 329.
6747 Safe 400S *(new)* ..... 399.
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4670 1.44 Meg Drive for PC/XT *(3½")* ... 89.
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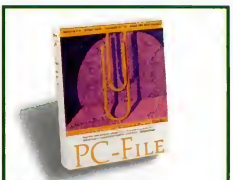

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3297 3½" DS/DD 720K Diskettes *(Qty. 10)* .. 13.
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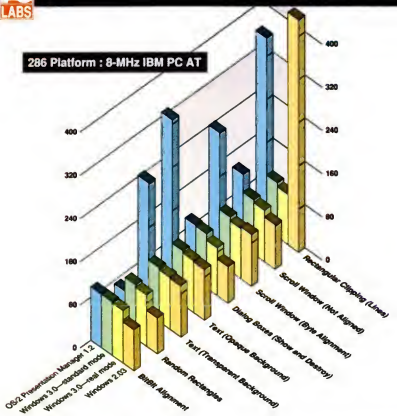
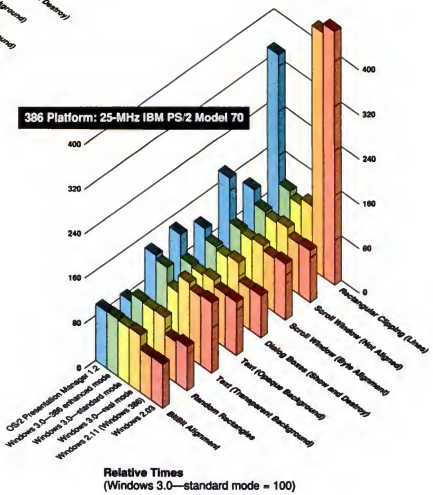
GRAPHICS PERFORMANCE TESTS: ENVIRONMENTS



Relative Times
(Windows 3.0—standard mode = 100)

The results of our graphics performance tests are subject to an overriding axiom: if you really want better graphics performance, buy a faster graphics board.

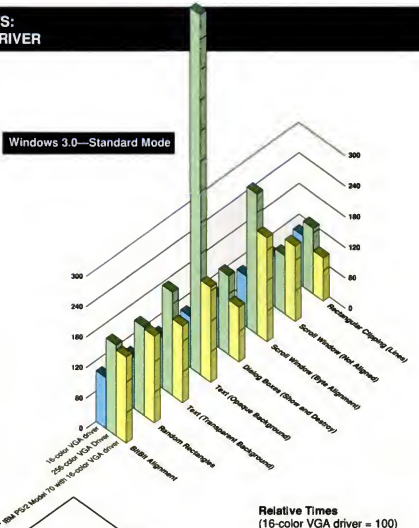
That said, *Windows* 3.0 looks pretty good on almost all the tests, although if you dusted off your version of *Windows* 2.03 and ran it on a 386, you'd see surprising speed on all tests except Rectangular Clipping (Lines). Apparently, Microsoft didn't change the basic *Windows* graphics algorithms substantially, though the fonts have been enhanced. Presentation Manager, by contrast, offers much more powerful facilities for manipulating graphics than *Windows* does—most importantly, the ability to rotate and distort a graphic image and the ability to scale fonts on the fly. This takes a lot of horsepower, and it shows; though Presentation Manager performed up to scratch on our PS/2 Model 70 testbed, it lagged severely on the slower IBM AT.

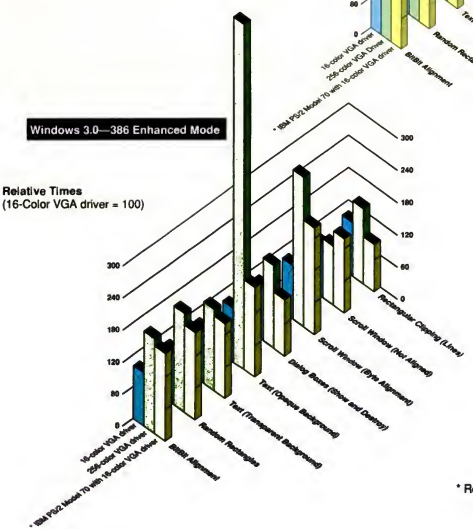


Relative Times
(Windows 3.0—standard mode = 100)

GRAPHICS PERFORMANCE TESTS: WINDOWS 3.0 256-COLOR VGA DRIVER

Windows 3.0 comes with a driver that lets owners of Headland Technology's Video Seven series of Super VGA boards take advantage of their boards' ability to display 256 undithered colors. This is very important in color graphics work, but such users will have to sacrifice performance. With the 256-color driver installed, most graphics tasks took from 1.2 to almost 3 times as long to complete. In the Text (Opaque Background) test, in which the driver had to fill the background as well as scroll the text, the ratio was over 7 to 1. Still, it's well not to overemphasize this disparity, for the fast Video Seven VRAM board goes far to compensate for the slowness of the 256-color driver. In most of the tests, the VRAM's 256-color mode isn't too much slower than the PS/2 Model 70's poky on-board VGA adapter.





* Reported for comparison.

ENDS

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WINDOWS 3.0 PERFORMANCE TEST RESULTS MEMORY BUFFER TESTS

PC LABS

The **Maximum Buffer Space** test determines the amount of memory that would be available to an application when running under the environment tested. We obtained this figure by filling all the available memory space and measuring the memory left just before the environment ran out of memory.

If the environment overflowed its memory buffer to disk when filled, it received a "Yes" on the **Disk Paging** test. A failure resulted in "No." Though disk paging causes the system to slow down drastically, this is still better than a failure.

286 Platform: 8-MHz IBM PC AT

	Maximum Buffer Space Size (kilobytes)	Disk Paging ■ / ❑
OS/2 Presentation Manager 1.2	2,184	■
Windows 3.0 standard mode	3,024	❑
Windows 3.0 real mode	288	❑
Windows 2.03	312	❑

386 Platform: 25-MHz IBM PS/2 Model 70

	Maximum Buffer Space Size (kilobytes)	Disk Paging ■ / ❑
OS/2 Presentation Manager 1.2	2544	■
Windows 3.0 386 enhanced mode	3120	■
Windows 3.0 standard mode	3288	❑
Windows 3.0 real mode	288	❑
Windows 2.11 (Windows/386)	264	❑
Windows 2.03	264	❑

■—Yes ❑—No

their experience with *Windows* 3.0 to move easily to Presentation Manager, which offers a similar user interface.

TEETHING TROUBLES

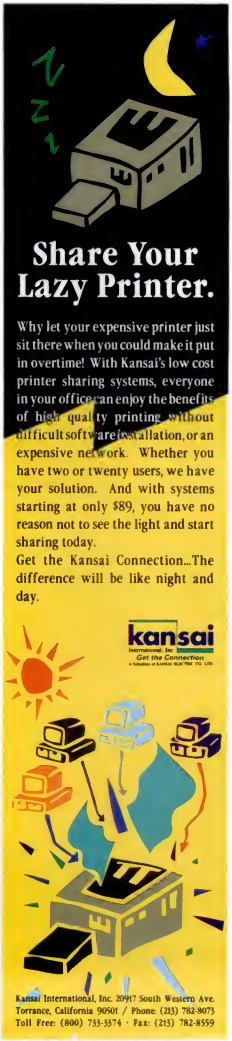
Converting to *Windows* 3.0 won't be all roses. Though the program's long gestation period has left it remarkably bug-free for such a complex program and has given application and system software developers a head start, such a radical jump in technology can't help but come with its problems.

The new standard set by *Windows* 3.0 requires all drivers to be rewritten. Though *Windows* 3.0 includes a comprehensive set of printer drivers, its screen drivers support resolution only up to 640 by 480 pixels. You'll need to get new drivers from your video board manufacturer if you want to use 800 by 600 or 1,024 by 768 resolutions under *Windows* 3.0.

Similarly, count on upgrading your network drivers and shells: Novell and most other vendors have released new versions to support *Windows* 3.0's networking features. In Novell's case, you can load the drivers directly into extended memory; otherwise you may face a RAM crunch. *Windows* 3.0 is incompatible with current versions of *QEMM-386* and *386MAX*, so you can't use them to load your drivers into high memory.

Another thing to be wary of is *Windows* 3.0's acute sensitivity to minor hardware variations. The product comes with an impressive-looking list of certified compatible hardware, which names just about every major vendor in the industry. But this masks the basic fact that the level of compatibility we've grown used to in the DOS world may not be enough for *Windows* 3.0. Our experience at *PC Magazine* has uncovered a number of hardware glitches, notably with 486 machines and with some hard disks that rely on the OnTrack *Disk Manager* to support disk partitions over 32MB. Most of these incompatibilities will be gradually cleared up as hardware manufacturers adapt to the new environment, but brace yourself for a certain amount of trouble in the transition period.

These caveats aside, *Windows* 3.0 is an easy choice to make. *Windows* has become a mature product with a large installed base and a family of applications that can effectively replace and go far beyond traditional character-based technology. By exploiting some of the power of the 80386 microprocessor, *Windows* offers an attractive upgrade from DOS with solid backward compatibility. The time to move is now. ■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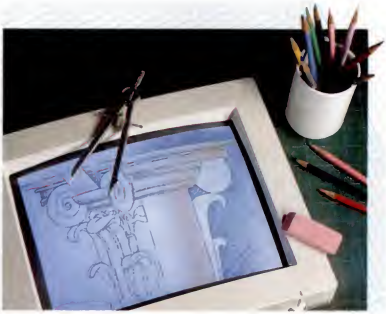


FIVE ILLUSTRATION PACKAGES

by Luisa Simone

For artists and business users alike, these five illustration programs supply high-quality drawing tools, flexible text handling, and dramatic color output. PC Labs tests *Adobe Illustrator, Arts & Letters Graphics Editor, CorelDRAW, MASS-11 Draw,* and *Micrografx Designer.*

Today's freehand illustration programs find themselves smack in the middle of a diversifying market. On the one hand, color PostScript and film-recorder drivers make it possible for professional illustrators to create high-quality images using standard PCs. On the other, business people have found these same programs to be a good source of quality images for their desktop publishing and presentation applications.

Satisfying this wide spectrum of users is possible because the basic toolbox is well defined. The five programs reviewed in this story, ranging from about $500 to $700—*Adobe Illustrator, Arts & Letters Graphics Editor, CorelDRAW, MASS-11 Draw,* and *Micrografx Designer*—offer the basic means to draw vector lines, curves, and geometric primitives. All can use different widths and endings to stylize lines and can fill objects with patterns, colors, and gradients. All come with transformation tools that let you size, skew, mirror, and rotate the elements in a drawing. And all can print the final image on a high-resolution output device or save it to a standard file format.

PHOTOGRAPH: THOM O'CONNOR; ILLUSTRATION: TRUAN FILIP

ILLUSTRATION SOFTWARE: SUITABILITY TO TASK

Today's illustration packages can handle a wide range of drawing tasks, but users differ in their needs. Our suitability-to-task scores provide informed subjective ratings for various tasks to help you decide which package is right for you. Compare them with the product reviews, the features table, and the sample output for a complete picture of what each product offers.

THE TASKS

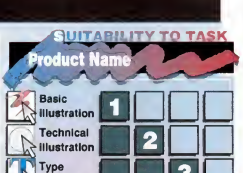
Each illustration program is rated according to its overall usefulness in four areas.

Basic illustration is an evaluation of the overall breadth and quality of the program's drawing and editing tools, as well as the flexibility with which you can create and manage the objects that make up a drawing. This score is also affected by the range and quality of fill patterns and blending options, the strength of the tracing and file import/export utilities, and the size and quality of the clip-art library that comes with the package.

Technical illustration evaluates high-end drawing tools plus some advanced features of importance to technical illustrators. CAD-like features such as multiple layers, dimensioning, and the ability to create global parts lists and to edit parts globally are important, as are the number and quality of line-handling options and the ability to import files in *AutoCAD*'s .DXF format.

Type handling is a measure of the ease and flexibility with which you can manipulate text, an important area for many graphic artists. It reflects not only the design of the text-editing functions but also the ability to do special effects with text (such as fountain fills or wrapping it around a shape) and the extent of the program's support for third-party fonts.

Color publishing measures the suitability of the product for professional publications, whether in print or in slide form. The number of colors, the breadth and robustness of the product's color models, and the quality and flexibility of its palette handling are the most critical factors. The ability to do color separation and to print on color output devices such as color typesetters and film recorders, is also important.



THE RATINGS

0 = unsuitable for the task
1 = poor
2 = adequate
3 = good
4 = excellent

THE VICTOR IS VECTOR

The advantage of a vector (or object-oriented) image, as opposed to a bitmapped (or raster) image is apparent at output time. A bitmapped image is created pixel by pixel at a fixed resolution. Enlarge the bitmap, and you also enlarge each individual pixel. You may own a 300-dot-per-inch laser printer, but if the image you send it is a low-resolution bitmap, you will still see jagged edges where there should be smooth curves.

Vector drawings, however, are stored as a series of instructions for drawing geometric elements such as lines and curves. Hence the integrity of a vector image is maintained even if it is greatly increased in size. The instructions that constitute a drawing are executed by the printer at its highest resolution, whether the printer is a 300-dpi laser or a 1,270-dpi typesetter.

If output were the only issue, other vector-based drawing programs would suffice for many business users. *Micrografx Draw Plus* and Digital Research's *Draw*, for instance, are easier to use and, at list prices of $229 and $299 respectively, cost several hundred dollars less than the programs in this roundup. *DrawPerfect*'s integrated working environment with *WordPerfect* appeals to those involved in graphical word processing. And although *Micrografx Graph Plus* and Lotus's *Freelance Plus* are primarily intended as data-driven graphics and charting programs, they both have significant freehand drawing capabilities.

THE BEZIER DIFFERENCE

Despite their strengths, none of the above programs gives users the most powerful tool available for creating and editing complex images: fully implemented Bezier curves. To be useful as a professional tool, a drawing package must not only use the Bezier mathematical formula to describe a curve between two anchor points but must also let you use the two tangent points (or handles) to influence the shape of the curve.

By manipulating only the two anchor points, or nodes, and their associated handles, it is possible to create myriad complex shapes in seconds. The graphical editing process is efficient because memory usage is determined by the number of nodes in an object, and each curve contains only two nodes. The shapes thus created are elegant because the mathematical description ensures smooth curves.

Although Bezier curves may seem like a feature that only a professional illustrator could love, their ability to edit an image infinitely, without degradation, is precisely what makes them valuable to the nonprofessional artist. Graceful trial and error is the most powerful tool a novice artist can hope for.

ART FOR AMATEURS

With clip-art libraries and autotraced images, even nonartists can produce acceptable, if not original, pictures. Autotracing has been promoted as the great equalizer of artists and nonartists, and as such is one feature that is intended almost entirely for business users. Issues of copyright aside, it is now quite feasible to scan an image, take the resultant bitmap, and create a vector-based drawing from it using a program's tracing functions (see the sidebar "Autotracing Saves Time and Talent").

Until recently, however, truly automatic tracing, in which every object in a drawing is outlined automatically, was left to standalone programs like *Adobe Streamline*. Both *Adobe Illustrator* and Computer Support's *Arts & Letters Graphics Editor* still require you to click on each object within a drawing in order to generate an outline.

But even though *CorelDRAW*, *Micrografx Designer*, and *MASS-11 Draw* have all adopted autotracing, their individual implementations differ dramatically. For

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example, CorelDRAW's tracing utility, CorelTRACE, offers a host of parameters that, when adjusted properly, can produce the ideal trace—which Corel has defined as the most accurate outline with the fewest number of nodes. *MASS-11 Draw* gives you less control over the tracing parameters: you can set only the number of vertices for each polyline and the degree to which irregularities in bitmapped lines are relaxed into smooth vectors. However, *MASS-11* has a unique feature that lets you determine the maximum number of objects it creates for any one trace. If the tracing exceeds the predetermined number of objects (between 1 and 1,900), *MASS-11*'s tracing program will create a new file for the overflow.

When dealing with complex images, extensive editing is often necessary in order to convert long nonsensical curves into sensible objects. Among the programs we reviewed, the one exception was *Micrografx Designer*, whose superior ability to locate object borders and to

COLOR PUBLISHING: How Can You Get Red When You Want Red?

by Gerard Kunkel

All the drawing packages reviewed in this issue can print your drawings in color, and all but *Adobe Illustrator* can show the colors on the screen. But how do you know they're the right colors? If your need for color extends only as far as your color printer, color accuracy will be of little worry. But if your drawing is the original art for a large-scale reproduction or for printing in a publication, reproducing it correctly involves a number of complexities.

The root cause of the difficulty is in color handling. Computers display color in an additive form, using the RGB (red, green, blue) color model, which corresponds directly to the power applied to the red, green, and blue guns of the video display. The guns are excited to different intensities in varying proportions to make different colors. When all three guns are fully powered, the screen phosphors are excited to full intensity and the human eye perceives the on-screen color to be white.

In contrast, process color printing relies on subtractive color, in which the layering of inks on paper subtracts components of the light being reflected to your eye. Each of the process colors (cyan, magenta, and yellow) absorbs its complementary color on the color spectrum: cyan ink absorbs red light, magenta absorbs green, and yellow absorbs blue. Thus, increasing the amount of cyan ink effectively filters out some of the red component in the image.

To create different hues with printer's inks, you must specify a color as a percentage of cyan, magenta, and yellow (the complements of red, green, and blue) plus black. This is called the CMYK color model (black is labeled K, so as not to be confused with blue). Since this has no direct relationship to the RGB color model of a computer display, it is possible to specify some colors on a computer screen that cannot be reproduced in the printing process.

PRINTING YOUR COLOR DRAWINGS

This difference in color models creates a difficulty in specifying the colors that will be printed. For instance, to create the solid red color of the *PC Magazine* logo on the cover of this issue in process color inks, you'd combine solid magenta with solid yellow. The specification would be: cyan, 0%; magenta, 100%; yellow, 100%; black, 0%.

Another industry-standard color model is the Pantone Matching System (PMS). The Pantone color model describes the mixing of industry-standard inks to create exact color hues. This is a long-standing, well-accepted way of describing solid-color inks to match a particular need. To create the *PC Magazine* logo in Pantone matched inks, you'd simply specify the number from one of the many available Pantone reference books: Solid PMS #185.

Most of the drawing packages let you specify this color directly, using the CMYK or Pantone models. However, because both the *Windows* environment and non-*Windows* drawing packages keep track of colors using the RGB color model, this specification must be translated by the software into an RGB format. Furthermore, the current crop of color PostScript output drivers do not support the CMYK color model, so they must be converted to RGB for output as well.

You can avoid this translation by specifying spot color overlays on output. In this scheme, the graphics software merely creates masks where the spot color ink will be applied. However, spot colors are typically used only for special jobs and are not a substitute for process colors.

MAKING PEACE

Going from RGB to CMYK requires some mathematical calculations to separate the composite RGB value into four separate values representing each of the printing inks, a process called *color separation*. Color separation was originally developed as a photographic process: by using red, green, and blue filters on a full-color image, a color separator can extract the component cyan, magenta, and yellow colors of the image for use on separate cyan, magenta, and yellow printing plates.

The initial conversion from red-green-blue to cyan-magenta-yellow is not too difficult, since the cyan (C) value is always the inverse of red (R), the magenta (M) value the inverse of green (G), and the yellow (Y) value the inverse of blue (B). On the 0 to 255 scale used by computers, the orange color R 255 G 130 B 0 would convert into C 0 M 125 Y 255. These figures can then be easily converted into printer's specifications, a scale from 0 to 100.

BLACK IN THE PICTURE

Where does the black ink come in? In theory, the printed color black can be created by combining 100 percent each of the cyan, magenta, and yellow inks. In practice, though, the actual color is a muddy brown due to the inaccuracy and impurity of printer's inks. For printing purposes, black must be created using solid black ink or black ink plus ink of some other color.

To understand this, let's study a dark color. If you specify a dark red in your computer system, upon printing, that color will need to be produced by some combination of magenta, yellow, and

search recursively for other objects within a defined region generated traces that require very little subsequent editing.

PROFESSIONAL TOOLS

If there are professional illustrators who use autotracing functions, they won't admit it. Instead, artists tend to worry about the fidelity with which their creations will be reproduced. Freehand illustration programs address these concerns with exhaustive file-export options and sophisticated color capabilities.

File import and export is an important issue for everyone, but most business users require only one or two standard formats. *Ventura Publisher* and *WordPerfect* audiences, for example, will be gratified to hear that the majority of these programs export both .GEM and .WPG files. But since the professional artist needs to produce output on a host of different output devices and to import his or her files into various application programs, the problems are more complex.

black inks. So how do you get black if the conversion converts only to CMY? The answer is that black must be created mathematically from the total CMY color.

For instance, suppose our dark red converts to C 60 M 100 Y 100. Since cyan is the component color that darkens the red hue, it can be replaced with the more stable black printing ink. To do this, the software would apply a mathematical formula that replaces cyan (C) with black (K). The resulting specification might be: C 0 M 100 Y 100 K 60. This technique, in which the smallest value in the component of three is replaced with the appropriate amount of black, is called *gray component replacement*.

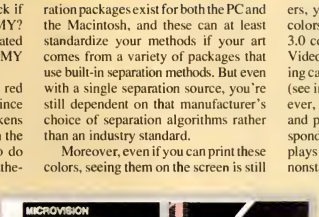
Undercolor removal is another technique for replacing combinations of color inks with black ink. In this process, each color in a gray is replaced by a corresponding amount of black ink. For instance, a 20 percent gray in most *Windows* applications has an RGB specification of R 204 G 204 B 204, which when converted to CMY would be C 20 M 20 Y 20. In printing, this color is more accurately reproduced by removing the common undercolor and replacing it with a suitable proportion of black. It would then be C 0 M 0 Y 0 K 20.

DIFFICULTIES

Unfortunately for your peace of mind, it is possible to come up with many variations on these techniques, and software developers do. Each manufacturer has its own method of making these conversions, which means that your printed results will vary depending on which package you use. Standalone color separation packages exist for both the PC and the Macintosh, and these can at least standardize your methods if your art comes from a variety of packages that use built-in separation methods. But even with a single separation source, you're still dependent on that manufacturer's choice of separation algorithms rather than an industry standard.

Moreover, even if you can print these colors, seeing them on the screen is still a problem. Most software used for publishing on PCs runs under *Microsoft Windows*, so the number of colors on the screen are subject to the limitations of the *Windows* graphical device interface (GDI). With its standard EGA and VGA display drivers, *Windows* 2.11 limits you to just 8 displayable colors in its standard EGA and VGA configuration, and even *Windows* 3.0 extends this to only 16 colors.

With a high-resolution display and graphics card and the appropriate drivers, you can see up to 256 undithered colors within *Windows*, and *Windows* 3.0 comes with a 256-color driver for Video Seven Super VGA cards. Dithering can also give the effect of more hues (see inset). True color publishing, however, requires the ability to both display and process 24-bit color, which corresponds to 16.7 million hues. Such displays and display adapters exist, but in nonstandard configurations, and require special *Windows* display drivers to work properly.



The screen display in these programs cannot accurately match the final output. The image on the left is what you see on the screen. The image on the right is what was actually printed after the RGB to CMYK conversion.

LET'S AGREE, IT'S RED!

Color handling could be painless. There are a few ingredients important to doing it right. The basic equipment would include a true 24-bit calibrated color display and similarly compliant color printing devices. But most important of all, color publishing desperately needs a standard color model, or at the very least a standard translation method between models.

Tektronix (Beaverton, Oregon) is working on a such a standard. The company proposes a single standard software layer that would sit between the application software and any output device, be it monitor, printer, film recorder, projection system, or print file. Ideally, this would reside within the computer's operating environment (Apple's System 7, *Windows*, or Presentation Manager). Such a standard would allow software developers to address only one color model, and the user would benefit from having one standard among many applications.

Put this all together and when you say red, you'll not just see red, you'll actually get red! ■

As resolution, color, and image complexity increase, so do legitimate worries about file export. It's still all too easy to get an error message when importing and exporting bitmapped .PCX files, for instance, because some programs, like *Micrografx Designer*, allow the last band of information to vary in size, while other programs, like *Arts & Letters Graphics Editor*, expect the last band to be padded. Neither approach is "wrong," according to the .PCX file specification, but the files are incompatible anyway. These types of problems multiply with the number of file formats a program supports. For example, it is not always possible to accurately translate images created using a CMYK color model, in which objects are filled with percentage mixtures of the four primary colors, to an HPGL file in which color is assigned to pen positions.

Indeed, even CMYK output direct from an illustration program to a printer involves a real, though hidden, translation process (see the sidebar "Color Publishing: How Can You Get "Red" When You Want "Red"?). Even though the color attributes that you've chosen for a picture may appear to be based on one of any number of color models (CMYK and Pantone are the two models used by desktop printers and printing presses), in reality all of the information is stored in native CRT mode: RGB. The algorithms that each program uses to interpret RGB values as subtle shades of gray or a process color can dramatically change the way an image appears on screen and on paper.

FEATURES ON FEATURES

While it's not unusual for artists to own several different illustration programs, culling the features they like best from each, business users tend to focus on one product that meets all their design needs. The conflicting goals of specialization and having an all-inclusive toolset can sometimes make high-end illustration programs overly laden with features intended for widely varying audiences.

Micrografx Designer, for example, addresses the needs of high-end technical illustrators with automatic dimensioning and layering features more typical of a CAD program, while at the same time catering to the business presentation market with a built-in slide-show utility. *CorelDRAW* includes editable PostScript patterns for the power user, yet simultaneously boasts of the special typographic effects that can be achieved in text mode. *Arts & Letters Graphics Editor* is the only program that allows professional-level desktop publishing users to export .EPS files with a *Windows* MetaFile (.WMF) header instead of TIFF, which means that you can see a color representation of an .EPS file for positioning purposes in *PageMaker*. But the *Arts & Letters Graphics Editor* is so named because a large percentage of the *Arts & Letters* installed base uses it to modify the extensive clip-art library supplied with the program.

Indeed, *Arts & Letters* plays up this idea of editing preexisting images more than any other program reviewed here. The newest version, 3.0, which should be shipping by the time you receive this issue, will even include a rudimentary charting option that converts limited data sets imported through the *Windows* Clipboard format (.CLP) into pie, bar, or scatter charts. Because *Arts & Letters* catalogs its clip art as a symbol set, you can use it to plot your data as eye-catching picto-

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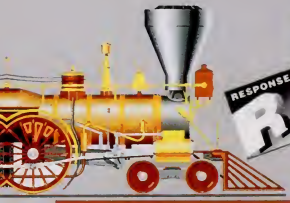

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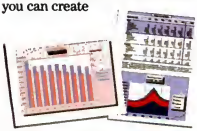

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grams in which different pictures represent different values or amounts.

SLIPPING THE BONDS

At one time there was a chance that the feature mania described above would top out along with available memory. But *Microsoft Windows* 3.0, which offers programs access to 16MB of extended memory, and disk-based virtual memory make more features inevitable. In fact, two of the products reviewed in this issue—*CorelDRAW*, Version 1.21, and *Arts & Letters Graphics Editor*, Version 2.1—are already *Windows* 3.0 capable, though you can also install them under *Windows* 2.11.

Microsoft Windows 3.0 may solve some long-standing memory problems, but it isn't a panacea for the difficulties involved in learning and using these powerful drawing programs. Don't be deceived by the fact that four of the six top illustration programs on the market are *Windows*-based. No two programs have similar toolboxes or menu structures. Compare, for example, the minimalist approach of *CorelDRAW* or *Adobe Illustrator* to the numerous specialized tools found in *Micrografx Designer*.

Not every product is *Windows*-based or needs to be. *MASS-11 Draw* clearly demonstrates its CAD roots with a pre-*Windows* interface; though its two-line menus may seem antiquated, there's no denying that its performance is better without the overhead of the *Windows* environment. The same is true of Digital Research's *Artline*, which is based on the company's *GEM* environment. If you can't afford the state of the art in high-performance hardware, it's worth looking into either of these packages.

REVIEW CRITERIA

To be included in this review of professional-level freehand illustration packages, a vector-based drawing program must offer fully implemented Bezier curves, have some kind of tracing facility, and support professional-level color output. The five products reviewed here meet these criteria; a sixth, *Artline* 2.0 from Digital Research, was not yet on the market at the time we tested (see the sidebar "Artline Enters the Big Leagues").

The PC Labs test script required each reviewer to recreate two test images. The drawing of a Corinthian capital originally appeared in the 1851 edition of *The Iconographic Encyclopedia of Science, Literature and Arts*. Our reviewers duplicated this image, which was originally created with the traditional tools of steel engraving, using Bezier and spline curves as well as black-and-white gradient fills.

The second of the test images, a jukebox designed by *PC Magazine*'s associate graphics director Gary Kaplow, required reviewers to make full use of the text-handling, autotracing, and color capabilities of the programs. For example, the logo "Let's Go to the Hop" required wrapping text to a curved path and directly editing the outlines of several letters. Drawing this image pushed the programs to their limits. *MASS-11 Draw* and *Adobe Illustrator*, for example, required the word "Hop" to be drawn from scratch because they won't let you enter copy as text and then convert it to curves.

The jukebox drawing in the second test image, supplied in the form of TIFF and .PCX files, was autotraced in order to convert the bitmap to a vector format. Several of the programs had difficulty generating an intelligent collection of outlines and objects from this admittedly complex image. The limitations differed for each program. Problems ranged from memory shortages that prevented a one-step trace to inflexible tracking parameters that resulted in inaccurate outlines. Even when a trace was successful, many of the curves required extensive editing. Our advice? Save yourself some gray hairs and trace only relatively simple images.

IT TAKES SKILL

Filling the various shapes, lines, and letters with color wasn't very difficult for any of the programs. Testing revealed that while advanced features may make it easier to achieve certain effects, anyone proficient with the basic tools can crunch out a picture. So, though *MASS-11 Draw* and *Adobe Illustrator* don't contain gradient fills (in fact, *Illustrator* still can't display color on the screen), you can achieve the proper effect by placing closely valued but separate color fills next to one another.

EDITOR'S CHOICE

- **CorelDRAW**
- **Micrografx Designer**

Though the competition has improved, *CorelDRAW* and *Micrografx Designer* retain the outstanding margin of quality that won them Editor's Choice last year. Both deserve it again this year.

Micrografx Designer ($695) is still the power user's choice. Version 3.0 has a larger feature set than ever; its customizable toolbox has a tool for just about anything imaginable, even such highly specialized symbols as parabolas and elliptical arcs. Much-improved type handling (though still not the best) as well as a precise and accurate autotracing utility further enhance its value. Between its extensive file export/import options, its CAD-like layering and dimensioning features, and its superb color publishing capabilities, *Designer* spans the needs of desktop publishers, technical illustrators, and presentation artists alike.

If you prefer a gentler transition to the world of computerized illustration or if you do a lot of work with type, look no further than the $595 *CorelDRAW*. In contrast to Micrografx, Corel has held the line on features, choosing not to upgrade *CorelDRAW*'s already complete and easy-to-use feature set. Newly added ancillary programs build wisely upon the program's considerable strengths. *CorelDRAW* still offers the best type handling in the business, and its WFNBOSS utility extends the program's spectacular typographic effects with just about any third-party font on the market. Meanwhile its autotracing utility (CorelTRACE) offers everything that *Adobe Streamline* does and then some, without a separate purchase.

An honorable mention must go to *Arts & Letters Graphics Editor*, a bargain at $695. As a professional drawing package, it has some very nice features (such as flexible blending) and includes 5,000 pieces of high-quality vector clip art in the bargain. Though memory management conflicts make creating very large drawings a problem under *Windows* 2.11, this restriction should be lifted in the *Windows* 3.0 version, which should be on the market by the time this issue hits the stands.

The way in which a program groups, layers, or otherwise organizes the plethora of objects in a drawing has a great impact on the amount of time and effort expended by the artist. Remember that something as simple as the five-word test logo is actually a complex collection of objects. The neon effect of the word "Hop," for example, must be achieved by layering several copies of the word so that each copy prints in a different line weight and a different color.

Micrografx Designer (and the upcoming *Artline 2.0*) offer the ability to segregate different parts of a drawing on transparent overlays, a feature familiar to CAD users but less common in the illustration world. This design can be a boon to organization, letting you temporarily clear up the clutter in a complicated picture by displaying only selected layers. Though *Arts & Letters* doesn't offer layers, it does allow you to lock objects so that you can't inadvertently change their attributes or position.

THE WHOLE PICTURE

In the final analysis the illustration package that you choose may not be the one with the longest list of features. Ease of use is a major issue for all users. But don't accept the general definition of the term. Ease of use should refer only to those tools that make your own life easier. The occasional business user may define ease of use as a program that doesn't require a refresher course after a hiatus of a few weeks, while a professional designer may find that access to third-party fonts eases his workload. No matter what your needs are, however, one of the five packages that we review here should offer the right tools.

Adobe Illustrator

When we reviewed it last year, *Adobe Illustrator* for the PC had just been introduced. Since then, as its competitors have gone through a cycle of enhancements and improvements, the $495 *Illustrator* has not been significantly updated.

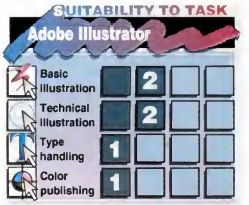
Illustrator's strengths include its ease of use and its seamless interface to other Adobe products. But its limitations are crippling for the professional user. Although it offers color output, *Illustrator* lacks on-screen color and is woefully short of the sophisticated typographic controls that graphic designers need.

Illustrator's toolbox is well designed, with a versatile pen tool that is good for drawing both straight lines and smooth curves. Its Average function lets you smooth curves by averaging the locations of two or more anchor points. Its zoom tool offers nine levels of magnification, ranging from 6.25 percent to 1,600 percent.

WEAK ON TEXT

But *Illustrator*'s text tools are adequate only if your typography needs don't go beyond the demands of simple business presentations; they aren't up to snuff for the fine tuning and detailed type manipulation required for professional use. You can specify typefaces, sizes, leading, and spacing in a single dialog box, but only one type style can be defined per setting. This means that if you need different typestyles in the same line, you must break the line up into many items that you must then carefully align with one another.

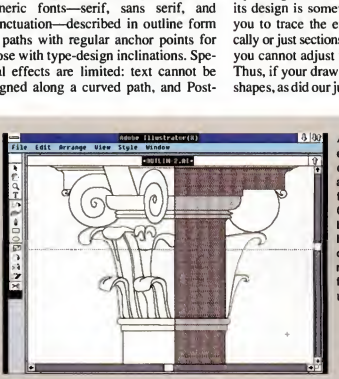
Illustrator also fails to distinguish between kerning (changing the space between two specific characters), and tracking (changing the space between all characters), which is a major handicap for users serious about typography. You cannot convert text to curves that can be edited, though Adobe does provide three generic fonts—serif, sans serif, and punctuation—described in outline form as paths with regular anchor points for those with type-design inclinations. Special effects are limited: text cannot be aligned along a curved path, and Post-



Script-based special type effects such as fills, outlining, and drop shadows are also lacking.

Potentially, one of *Illustrator*'s strongest features is its easy-to-use and efficient *AutoCAD* .DXF conversion program, which is critical if you prepare technical documentation in which many illustrations begin as CAD files. One minor drawback about the conversion process is that the resulting *Illustrator* files contain lots of short paths as opposed to long paths with lots of segments. This results in very few closed contours, which in turn makes filling converted .DXF files virtually impossible without major path editing. Since these files are also big, they slow the program considerably when they're loaded into memory.

A year ago *Illustrator*'s autotracing feature (which accepts TIFF, .PCX, and .PNT images) was impressive, but today it pales against the competition. Although its design is somewhat flexible—letting you to trace the entire image automatically or just sections of it, shape by shape—you cannot adjust the tracking accuracy. Thus, if your drawing has many intricate shapes, as did our jukebox test image, you



Adobe Illustrator's easy-to-use Bezier curves make it an acceptable choice for line art like our Corinthian capital, but its limited color handling and lack of on-screen color render it unsuitable for many other uses.

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Circle #144 on R.S. Card for Graphic Displays/Circle #277 on R.S. Card for Color Printers/Circle #262 on R.S. Card for Digitizing Tablets

will end up with a largely unusable trace containing globs instead of accurately traced areas. In order to get acceptable tracing, you need to spend an additional $395 for *Adobe Streamline*. Compare this cost with the $595 for *CorelDRAW*, for example, which bundles its excellent CorelTRACE utility into the package for no extra charge.

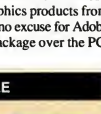
LIMITED COLOR SUPPORT

Illustrator's color support is very limited. It supports color PostScript output but it does not show the colors on the screen, a capability that is essential by today's graphic arts professional standards. And it supports only the CMYK color model—not the popular RGB, hue/saturation/brightness (HSB), or Pantone color systems.

You cannot generate color separations directly from *Adobe Ilustrator;* instead, you must transfer the data to *Adobe Separator*, a utility program that currently runs exclusively on the Macintosh. Halftone screen resolution cannot be user-defined, and you cannot scale output or calibrate registration marks.

Illustrator is fundamentally adequate in its basic drawing functions, but it lags far behind the state of the art, especially in its type-handing features and lack of on-screen color. Given its professional-level price, we have a right to expect more, especially since all these features are found in the Macintosh version of *Illustrator*. Now that *Microsoft Windows* 3.0 makes a good platform for graphics products from the Macintosh, there's no excuse for Adobe not to bring the full package over the PC.

FACT FILE



***Adobe Illustrator, Windows* version**
Adobe Systems Inc., 1585 Charleston Rd., P.O. Box 7900, Mountain View, CA 94039; (800) 344-8335, (415) 961-4400.
List Price: $495 (includes a runtime version of *Microsoft Windows*).
Requires: IBM AT, PS/2, or compatibles; 640K RAM, 256K expanded memory; hard disk; EGA or VGA graphics adapter; mouse; *Microsoft Windows* 2.0 or later.
In Short: The PC version of *Adobe Illustrator* has a few nice features, but its critical limitations in the areas of on-screen color support, pattern fills, and type handling make it unsuitable for professional use.

CIRCLE 401 ON READER SERVICE CARD

Until then, *Illustrator* is hardly a match for its robust competitors.
—*Isaac Victor Kerlow*

Arts & Letters Graphics Editor

Computer Support Corp., the manufacturer of *Arts & Letters,* started out by producing volumes of attractive clip art. However, the drawing program that comes with the collection to help users customize these images is worthy of serious consideration by the experienced graphics artist. Version 2.1, which sells for $695, lets you combine your drawings with high-quality color bitmapped images and print giant PostScript images. This is not a tool for the studio drudge; the package invites original artwork.

SIMPLE INTERFACE

The initial orientation toward the clip-art user is responsible for the *Arts & Letters Graphics Editor's* clear-cut interface. Although at first it appears a little unorthodox to the dedicated graphic artist used to having many sophisticated drawing tools immediately at hand, ultimately it proves quite easy to use.

The basic square, circle, and triangle tools common to most toolboxes are not available until you pull down the Draw menu, where they are grouped at the top as symbols. This arrangement leaves more room in the toolbox for free-form editing tools. Since the icons for editing control points and for qualifying curves and joins reflect their settings, a glance is all that's needed to detect if your control and free-form points are active and whether the curve slope and smooth joins are being maintained.

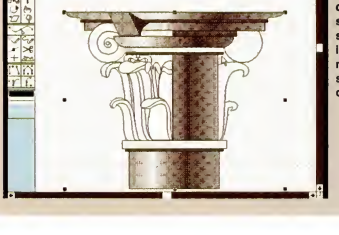
EASY BLENDS

Arts & Letters is notable for the exceptional control it gives you over blends. The program not only interpolates from one color or shade to another, but from one shape to another simultaneously. Indeed, the program doesn't even provide radial or gradient fills as separate tools because it's so easy to make your own.

SUITABILITY TO TASK
Arts & Letters Graphics Editor

Basic illustration			3	
Technical illustration		2		
Type handling			3	
Color publishing			3	

My rendering of the Corinthian capital in the test image, for instance, proceeded from gray to white highlight to dark shadow and back to gray, requiring three separate tonal ranges blended from one shape to another, different shape. This is a challenging problem, but with *Arts & Letters* it proved surprisingly easy to do. We simply created a source shape with a solid interior, activated the blend option, set the number of in-between stages, and then duplicated and blended until the desired tonal range was reached. The printed results were handsome, with a clean, smooth blend.



***Arts & Letters Graphics Editor* is a whiz at blends. You can interpolate both shape and color or shade over several intermediate steps, making for smooth shading on irregular objects.**

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CIRCLE 241 ON READER SERVICE CARD

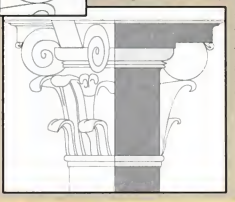
ILLUSTRATION SOFTWARE: The Results Compared

PC Labs asked the artists who reviewed these programs to base their evaluations upon the ease with which the programs could create two test images.

To test the program's basic drawing capabilities, we asked each artist to recreate a drawing of a Corinthian capital, taken from *The Iconographic Encyclopedia of Science, Literature and Arts*, originally published in 1851. The goal was to create a simplified version of the original using the appropriate computerized drawing tools, such as straight, curved, or freehand lines, partial element symmetry, rotation and skewing effects, and pattern or gradient shading.

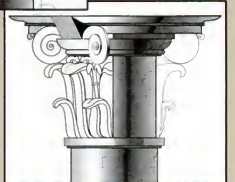
To test text handling, autotracing, and color capabilities, the artist was asked to recreate a color image of a jukebox, originally drawn by *PC Magazine*'s associate graphics director, Gary Kaplow. We supplied the jukebox drawing as a black and white bitmapped image in both TIFF and .PCX formats for autotracing purposes. We gave a color printout of the entire drawing to each reviewer to use as a reference for the text logo and the background design. The logo "Let's Go to the Hop" required the reviewers to wrap text to a curved path—using either a program's automatic functions or by manually placing the letters. The logo also included one word, *Hop*, that needed to be distorted by editing the nodes on the outlines.

Each package was tested on a 25-MHz Compaq Deskpro 386 equipped with a 60MB hard disk, 640K of base memory, a VGA graphics card and monitor, and a mouse. Programs that took advantage of extended or expanded memory were supplied with it. Black-and-white output was printed on a QMS PS-2200 PostScript printer; color output, on a QMS ColorScript printer.



The Corinthian column test image clearly demonstrates *Adobe Illustrator*'s strengths: line drawings based on Bezier curves are easy to manipulate. However, the program lacks gradient or fountain fills, requiring the artist to use flat tints to distinguish the different parts of the column.

Though *Adobe Illustrator* will not display color images on screen, the test logo, whose colors were specified using the CMYK model, printed out just fine in full color. The word *Hop* was created using one of the two supplied outline fonts, which are defined internally within the program as curves and therefore can be reshaped like any other drawing.



Arts & Letters Graphics Editor has a unique approach to shading: you create two shapes with two different colors and then use the blend tool to create intermediate objects. The method takes advantage of shape and color interpolation to achieve very subtle shading effects for irregularly formed objects. Notice how the shading on the curved pediment in the detail is itself curved.

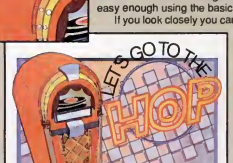
The catch is that to accomplish this effect, *Arts & Letters* must create a separate object for each tone in the gradient. Drawings with lots of gradients use lots of memory, quickly hitting the 640K memory barrier imposed under *Windows* 2.11. (The *Windows* 3.0 version should solve this problem).

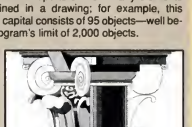
CorelDRAW's simple toolset is more than capable of producing this image, right down to the gradient fills and the complex arrangements of closed and open curves. The program does not supply fill patterns, but repeating precisely positioned vertical lines in order to create a texture pattern on the column itself was simple because the macro function made it easy to record and play back mouse movements and command sequences.

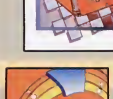
The vector outline of the jukebox illustration was generated by CorelTRACE, *CorelDRAW*'s fine autotracing utility. The gradient fills take full advantage of the program's support for the CMYK color model. Visual diversity was easily introduced into the tracing by manipulating the direction and angle of the gradient fills. Needless to say, *CorelDRAW*'s extensive type-handling capabilities made creating the entire text logo a snap.

As the detail of the jukebox clearly illustrates, *MASS-11 Draw* does not support gradient fills. Instead of a smooth transition from one color to the next, you must use individual rectangles of closely hued (but separate) colors. Though you cannot convert text strings to curves, drawing the word *Hop* from scratch was easy enough using the basic line and polyline tools.

If you look closely you can probably discern which (nearly identical) portions of the Corinthian capital were created by using the program's copy, sizing, and skewing commands. *MASS-11 Draw* reports on how many elements are contained in a drawing; for example, this Corinthian capital consists of 95 objects—well below the program's limit of 2,000 objects.

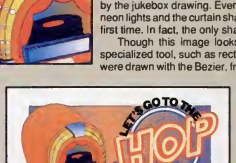


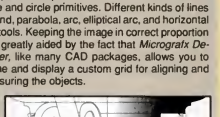




The intelligent design of *Micrografx Designer*'s autotracing utility is demonstrated by the jukebox drawing. Even complex relationships, like the nested arcs of the neon lights and the curtain shape in the display window, were traced correctly the first time. In fact, the only shape that required editing was the stack of records.

Though this image looks simple, each portion of it was created with a specialized tool, such as rectangle and circle primitives. Different kinds of lines were drawn with the Bezier, freehand, parabola, arc, elliptical arc, and horizontal line tools. Keeping the image in correct proportion was greatly aided by the fact that *Micrografx Designer*, like many CAD packages, allows you to define and display a custom grid for aligning and measuring the objects.





MEMORY PROBLEMS

At this point, however, we ran into memory errors during printing and other operations. According to Adobe System's technical support, these errors are traceable to a bug in *Microsoft Windows*' use of expanded memory, which conflicts with *Arts & Letters*' multithreaded programming design.

To get around the problem, you must disable *Windows*' use of expanded memory before starting *Arts & Letters*, which effectively limits you to the 640K of conventional memory. Within the 640K limit, each drawing should be able to hold 800 to 900 objects, but in practice, the complexity of our objects limited us to about 600. In our test image, since we had initially set up 36 stages for each blend and had three ranges, just one narrow segment of the column ended up being composed of 109 objects.

Though our PC Labs tests deliberately pushed the program to its limits, *Arts & Letters*' inability to use expanded memory represents a severe hindrance to professional users. Fortunately, the vendor says that this problem should be eliminated in the *Windows* 3.0–compatible version, which will remove the limits on the size of the workspace and therefore on the number of objects in a drawing.

The program's redraws were somewhat slow. The vendor notes, however,

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that the drawing of Bezier curves can be speeded by the addition of a math coprocessor; you can obtain a free upgraded version of the program to work with it.

CLIPPING AND TRACING

Arts & Letters is clearly the king of clip art among these packages. It comes with 3,500 pieces of high-quality clip art (most of which is sent to you when you register your package), and extra-cost libraries are also available. The collection includes a generous range of icons for many businesses and industries, common geometric shapes, borders and other accent symbols for page design, and pictorials. A well-written Tutorial & Techniques manual, which gives handy instructions for manipulating and embellishing the clip art, offers guidelines for handling copyrighted material.

Arts & Letters comes with 3,500 pieces of high-quality clip art; extra-cost libraries are also available.

Arts & Letters does not have an autotracing utility. It requires you to indicate manually which drawing segments to trace and traces only black-and-white images. But within these limits, the program worked well. The solid interior option recommended in the tutorial proved an unwise choice for our autotracing test image. Resetting to the default and adjusting a few options produced a significantly more accurate trace; it took longer, but the superior result was worth the extra time and effort.

Unfortunately, when we tried to trace the jukebox in our second test image, we ran out of memory and the program crashed. Nevertheless, hand-tracing the jukebox was not difficult thanks to the ease with which we could convert lines to curves and curves to lines, add and delete nodes, and shape rounded corners.

TYPE HANDLING

Arts & Letters has capable type-handling and text-manipulation features. You enter text into a dialog box that displays up to four lines of text at a time and allows vertical and horizontal scrolling. (You can also import text files up to 5,000 characters long).

You can fit text to any shape using the top, center, bottom or baseline of the text as the reference point. Once bound to a shape, the text can be edited like any other line of text, or the associated shape can be easily adjusted and the text redrawn to fit.

The text may be filled with a solid or dithered color, or with one of the 18 dithered or 18 simulated halftone raster patterns that come with the package. By varying the interior fills and the line weights and colors, you can expand your text options considerably.

Arts & Letters comes with 15 outline typefaces, and you get an additional 32 typefaces when you return the registration card. You can adjust type size, leading, kerning, character and word spacing, condensation, and justification on a single Type Attributes menu.

The program gives you very few clues about the typeface until you transfer the objects onto the screen. There is no preview font box—as with *CorelDRAW* and some other packages. Such a box would be particularly helpful given *Arts & Letters* unfamiliar nomenclature for typefaces: for example, Modern Round-28 resembles Helvetica Round and, con-

FACT FILE

PC MAGAZINE

***Arts & Letters Graphics Editor*, Version 2.1**
Computer Support Corp., 15926 Midway Rd., Dallas, TX 75244; (214) 661-8960.
List Price: $695
Requires: IBM PC/AT, PS/2, or compatibles; 640K RAM; hard disk; EGA or VGA graphics adapter; mouse; *Microsoft Windows* 2.11 later, DOS 3.0 or later.
In Short: Though it's sold as an adjunct to *Arts & Letters*' large and varied clip-art library, *Arts & Letters Graphics Editor* is powerful enough for professional-level drawing, especially in its exceptional control over blends. But memory management difficulties when running under *Windows* 2.11 severely limit the size and therefore the complexity of your drawings. Look for an upgraded version (3.0) that will run under *Windows* 3.0 later this year.

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fusingly, the number 28 does not refer to the point size.

COLOR HANDLING

For color output, *Arts & Letters* gives you three color models: RGB, Hue (a modified hue/saturation/brightness scheme), and CMY. It does both four-color and spot-color separations; however, since it uses only three-color models internally, it does not support CMYK. The program's file import and export functions are robust. It imports TIFF, .PCX, .EPS, and 24-bit Targa file formats, as well as *Windows* Metafile (.WMF). It exports all of these, plus SCODL for use with film recorders. The Decipher utility, a PostScript file interpreter, lets you do gradient fills and speeds up printing into the bargain.

The program includes a generous selection of color palettes. For instance, we used the CMY-based color chart to select from 360 named colors grouped into 14 palettes. You can use the scroll bars to mix custom colors, watching a generously sized current color bar until you get just the right color. After you have mixed a color, you can save it as a separate palette file or append it to an existing palette file. Oddly, *Arts & Letters* does not let you use dithered colors for lines.

A PLACE IN YOUR STUDIO

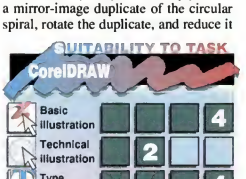
Arts & Letters Graphics Editor has many strengths and produces sharp, clear, printed images that print rapidly on color PostScript devices. Its drawing tools and color palette choices are generous, and its clip-art library is a real advantage for the nonartist. Yet, given the memory management problems we experienced, you'd be better off waiting for the *Windows* 3.0 version, which should be shipping by the time you read this.

—*Maureen Jones*

CorelDRAW

A year after its introduction, the $595 *CorelDRAW* from Corel Systems Corp. remains one of the few PC products to deliver on the promise of graphically oriented application programs: it is truly both powerful and easy to use.

The deceptively simple toolbox contains only nine icons (pointer, node edit, pencil, rectangle, ellipse, text, pen nib, fill color, and magnifying glass), but these few tools were all that was required to complete the PC Labs test images. Most of Corel's tools do double and even triple duty. For example, to create the foreshortened spiral on the drawing of the Corinthian capital, you can simply create a mirror-image duplicate of the circular spiral, rotate the duplicate, and reduce it



nonproportionately, all using just the Arrow Selection tool.

The node editing tool is just as efficient. It is smart enough to change modes depending upon whether you are editing curves (in which case you can add, delete, join, break, or transform nodes on the Beziers) or text (in which case you can affect kerning, word spacing, and leading). The consistency with which tools are switched from mode to mode and a menu structure in which it is impossible to lose your bearings make *CorelDRAW* easy.

Advanced users will be pleased with *CorelDRAW*'s ability to fine-tune the compact toolset. Although you must allow Corel to assign the best-fitting curve to the outline you've created, you can set the sensitivity of the freehand tracking (as well as the auto-join function and the straight-line threshold) in the Preferences Menu. I found that the loose tracking setting—about seven pixels—produced the smoothest curves yet required relatively little subsequent editing.

Surprisingly, *CorelDRAW* contains no fill patterns per se. However, the availability of 50 PostScript fills and a capable macro function that makes it possible to repeat and precisely position selected objects offers solid alternatives.

WIREFRAMES

CorelDRAW insists that you create and modify images as wireframe drawings. The program's Display menu allows you to adjust your working environment by showing—or suppressing a preview win-

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dow, status line, and ruler. Even with the preview window displayed, you can speed the program's response time by turning automatic updates off.

A status line at the top of the working space gives you important, albeit incomplete, information about your drawing; although you can easily see the fill color or how many nodes a curve contains, there is no way to get numeric information about the size or position of an object.

Other mildly irritating glitches deserve fixes. Though you can snap to a customizable grid of inches, centimeters, picas, or points, you can't display the grid. And a snag with the Snap to Grid function makes it impossible to align objects that were created before Snap was turned on.

TESTY IMAGES

The two PC Labs test images revealed all of the strengths as well as the one major weakness of *CorelDRAW*. Creating the outlines, color fills, and gradients that were necessary for the Corinthian capital and the jukebox was easy enough, but managing the arrangement and styles of the numerous objects was at times downright frustrating.

For example, *CorelDRAW* allows you to copy color and outline attributes from one object to another. This works well for simple drawings, but we found that clicking on the right wireframe outline was

ARTLINE ENTERS THE BIG LEAGUES

by Mark Wilson

Version 2.0 of *Artline* from Digital Research is built on the foundations of *GEM Artline*, reviewed in "Fine Lines: The PC As Illustrator" (*PC Magazine*, June 27, 1989). But to judge from the prerelease version we saw, its many enhancements and unique extensions will make it a big step up from its predecessor. Developed in collaboration with a team of programmers from CCP Development of Marburg, West Germany, *Artline* 2.0 is planned for release this summer. It will cost $595.

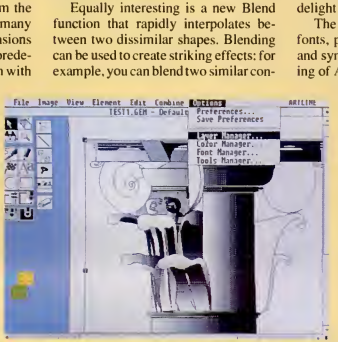
Artline 2.0 is still based on Digital Research's *GEM* operating environment, but now it incorporates *GEM* and runs as a standalone application directly from the DOS prompt. *Artline* will come with drivers for a wide variety of hard-copy devices, including color and monochrome PostScript printers, Hewlett-Packard-compatible plotters, and Linotronic and Agfa phototypesetters.

Like most illustration software, *Artline* is not a small program; it requires at least 3.5MB of hard disk space plus an EGA or VGA display system, but it also ran quite happily on an 8-MHz AT. *Artline* takes advantage of expanded memory conforming to LIM 3.2 or later.

WHAT'S NEW

Digital Research has added a number of basic drawing and editing tools to *Artline* 2.0. A new Quill tool acts as the main drawing tool, letting you draw single vectors, polygons, and or Bezier curves. A freehand curve tool makes a very useful supplement: simply draw a line or curve with a mouse, and *Artline* automatically converts it to a Bezier curve with the appropriate anchor and direction points.

Equally interesting is a new Blend function that rapidly interpolates between two dissimilar shapes. Blending can be used to create striking effects: for example, you can blend two similar con-



centric shapes to create an attractive blended color pattern.

Rounding out *Artline* 2.0's image-management functions is a a well-designed layer manager, a powerful tool for arranging and layering groups of elements. This feature not only allows you to separate or combine parts of complex drawings on different "transparent" layers but is also useful for making sequenced slide shows in much the same fashion as presentation software.

Text handling has also been improved. Although text entry is not WYSIWYG—after selecting the location for the text on the drawing, you must type it into a small box before it appears on the screen—once entered it can be skewed, rotated around curves, scaled, and manipulated to your heart's delight while still remaining editable.

The shipping version will include 35 fonts, plus two collections of dingbats and symbols, and will support the mixing of Agfa Compugraphic, Adobe format, and Bitstream fonts in the same drawing.

STOP-MOTION AUTOTRACING

Autotracing is an important feature of illustration software, and *Artline* 2.0 competes well in this area. Its autotracing function lets you stop midway through a trace to adjust the sensitivity settings. This is very handy if you're tracing an image that combines broad curves with intricate detailing.

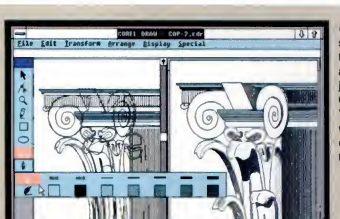
You can use a relatively loose trace on broad areas to avoid creating too many nodes, and you can shift into a more precise trace to capture the more detailed parts of the image. *Artline* also offers an expanded set of file import and export formats. DRI claims that *Artline* will include the ability to trace color and grayscale images in its final version.

CUSTOM TOOLS

By far the most interesting thing about the new *Artline* is its customizable toolbox. This innovative feature lets you construct a simple or complex tool from any of the standard menu selections or options, then add it as an icon to your graphics toolbox for instant mouse ac-

proportionately more difficult when the image in question contained lots of overlapping shapes. This problem could be fixed with complicated palette menus, but improved object-management capabilities would be a better solution.

At the moment all elements of a drawing must reside on one—often cluttered—layer. Though you can group items together, you are restricted to a maximum of ten nested groups. Fortunately, color mixtures (using either the Pantone Matching System or the CMYK four-color model) and line widths (including calligraphic pen nibs) are immediately accessible from the toolbox.



CorelDRAW's simple, flexible toolbox is well adapted to intricate jobs like our Corinthian capital. You can specify line width and color directly from the toolbox.

cess. This makes it quite easy to customize the interface to your work.

For example, you might save different sets of autotracing options for easy selection or create macros to perform frequently used operations with a single mouse click. It is even possible to construct entire libraries of the most useful tools and macros for specialized work such as technical illustration or graphic arts. An icon manager lets you create your own icon symbols for your custom tools.

COLOR IT EVERY WAY

GEM Artline supported color output, but color has postively bloomed with *Artline* 2.0. The prerelease version we saw supports three major color models (CMYK, RGB, and hue/saturation/brightness), and the final version is supposed to support the standardized Pantone color system as well, even to the extent of letting you preview Pantone colors on the screen.

The program also offers plenty of options for controlling color PostScript devices, including graduated fills and patterns. It will also accept PostScript input files. It offers spot color and four-color separations, plus trim and registration marks. The handy color manager helps you control this proliferation of possibilities and save your options in files for later recall.

Artline 2.0 is an ambitious product that expands on almost every function of its predecessor. Its range of drawing and text tools, as well as its color-handling facilities, should satisfy any professional artist or designer, while its customizable toolbox offers a powerful approach to the user interface dilemma of software that aims to be different things to different people. When it arrives, *Artline* 2.0 will be a worthy competitor. ■

TEXT IS BEST

Simply stated, *CorelDRAW* vastly outperforms its competitors when manipulating text. Finding the right typefaces for the PC Labs test logo was as easy as scrolling through the 102 proprietary type outlines (35 of which match the typefaces of the Apple LaserWriter Plus) that come bundled with the program. A text-editing dialog box that pops up when you add words to a design contains formatting options such as type size and attributes (boldface, etc.).

Amazingly, *CorelDRAW* allows you to wrap text along a curved path, enlarge, rotate, skew, and even individually reposition letters—all in text mode. Had I discovered a spelling error in the test logo I could have simply selected the text block and edited the copy while it was still curved around the circle.

Text transformations can be handled interactively using the node edit tool or via a dialog box in which you can adjust positioning in em-sized increments or change the rotation angle. As long as you don't convert type to curves (in which case you are actually dealing with a drawing of a letter) all of your transformations can be undone by invoking either the Align Text to Baseline or the Straighten Text menu items.

CorelDRAW's type-handling capabilities are further enhanced by the addition of WFNBOSS, a font-conversion utility that gives you access to more than 4,300 third-party typefaces. You can translate vector outlines from Adobe, Bitstream, Agfa Compugraphic and Digi-Fonts, as well as those produced by ZSoft Publisher's Type Foundry, to Corel's proprietary format. The program itself requires only that you indicate which format you want to convert and which subdirectory contains the original outlines. Most typefaces converted flawlessly. However, I found that several complex symbols from Digi-Fonts contained too many nodes to be converted without error. The inconsistencies in the letterforms were noticeable only at large point sizes, however.

TRACING GALORE

Included in this version of *CorelDRAW* is a separate tracing utility, CorelTRACE, which to a large extent duplicates the

FACT FILE
EDITOR'S CHOICE

***CorelDRAW*, Version 1.21**
Corel Systems Corp., 1600 Carling Ave., Ottawa, Ontario, Canada, K1Z8R7; (613) 728-8200, (613) 728-1990.
List Price: $595
Requires: IBM AT, PS/2, or compatibles; 640K RAM; hard disk; EGA or VGA graphics adapter; mouse; DOS 3.0 or later, *Microsoft Windows* 2.03 or later.
In Short: Though *CorelDRAW*'s illustration functions haven't changed since last year, it's still one of the best illustration packages you can buy. A new utility for converting third-party typefaces and an excellent autotracing utility round out its excellent tools.

CIRCLE **403** ON READER SERVICE CARD

ILLUSTRATION SOFTWARE: SUMMARY OF FEATURES

Products listed in ascending price order

	Adobe Illustrator	CorelDRAW	Arts & Letters Graphics Editor	MASS-11 Draw	Micrografx Designer
List price	$495	$595	$695	$695	$695
LINE AND BOX TOOLS					
Straight lines	■	■	■	■	■
Orthogonal lines	■	■	■	■	■
Squares	■	■	■	■	■
Rectangles	■	■	■	■	■
Rounded corners	❑	■	■	■	■
User-controlled corner rounding	❑	■	❑	■	■
Line weights can be specified in points	■	■	■	■	■
Invisible lines	■	■	■	■	■
User can select style for line caps	■	■	■	■	■
Arrowheads	❑	■	❑	■	■
CURVE TOOLS					
Freehand curves	■	■	■	■	■
Arcs	■	■	❑	■	■
Circles	■	■	■	■	■
Ellipses	■	■	■	■	■
Pie charts	❑	❑	❑	■	■
Curves can be based on:					
Splines	❑	❑	■	❑	❑
B-splines	❑	❑	❑	❑	■
Vectors	❑	❑	■	❑	❑
Bezier curves	■	■	■	■	■
Offers automatic curve smoothing	■	■	■	■	■
Closes curved paths automatically	■	■	■	■	■
Uses control points to reshape curves	■	■	■	■	■
Uses handles to scale curves	■	■	■	■	■
User can turn control points on or off	❑	■	■	■	■
User can insert or delete curve points	■	■	■	■	■
User can view tangents for active curves	■	■	■	■	■
PATTERNS AND FILLS					
Edits and stores new patterns	❑	❑	❑	❑	■
Radial fills	❑	■	■ (custom blends)	❑	■
Fountain fills	❑	■	■ (custom blends)	❑	■
TRANSFORMATION TOOLS					
Selects and/or moves objects	■	■	■	■	■
Replaces arrow with crosshair	❑	❑	❑	■	■
Rotates	■	■	■	■	■
Skews or shears	■	■	■	■	■
Flips and/or mirrors	■	■	■	■	■
Clips and/or cuts	■	■	■	■	■
Resizes	■	■	■	■	■
Converts polygonal elements to curves	❑	■	■	■	■
Copies attributes from object to object	❑	■	■	■	❑
Converts objects to polygons	❑	■	■	■	■
Shape clipping	❑	■	■	❑	■
Shape interpolation	❑	❑	■	❑	❑
DISPLAY AND EDITING FUNCTIONS					
Edits multiple documents	■	❑	■	■	■
Edits multiple copies of active elements	■	■	■	■	■
Groups or regroups elements	■	■	■	■	■
Aligns elements in relation to page	❑	❑	■	■	■
Aligns elements in relation to one another	❑	■	■	■	■
Moves elements to back or front	■	■	■	■	■
User-definable grid	❑	■	■	■	■
Snap-to grid or guides	❑	■	■	■	■

—Editor's Choice ■—Yes ❑—No

CONTINUES

ILLUSTRATION SOFTWARE: SUMMARY OF FEATURES

	Adobe Illustrator	CorelDRAW	Arts & Letters Graphics Editor	MASS-11 Draw	Micrografx Designer
Pivot point can be specified interactively	■	■	■	■	■
Number of zoom levels	9	Variable	Variable	6	4
Automatic scroll	■	❑	❑	■	■
Ruler measures in inches/cm/picas/points	■	■	■	■	■
Measuring tool	❑	❑	■	■	■
IMAGE MANAGEMENT					
Dimensioning	❑	❑	❑	❑	■
Defines page size	❑	■	■	■	■
Sets page margins	❑	❑	■	■	■
Maximum number of pages in a document	9 (tiled pages)	1	Variable	1	54
User can view and print list of elements	❑	❑	■	❑	■
User can globally edit elements	❑	❑	■	■	■
User can place elements outside of page	❑	■	■	❑	■
Number of layers	1	1	Unlimited	1	64
TYPE HANDLING					
Type display	Bitmapped	Vector	Vector	Vector	Vector
On-screen text editing	❑	❑	■	■	■
Kerning and tracking	■	■	■	■	❑
Leading in point increments	■	❑	■	■	■
Converts text to curves	❑	■	■	❑	■
Wraps text around curved path	❑	■	■	❑	■
Uses third-party fonts	■	■	■	❑	■
Bitstream Fontware	■	■	■	❑	■
Adobe fonts	■	■	■	❑	■
FILE IMPORT AND EXPORT					
Vector formats (imports/exports):					
.CGM (Computer Graphics Metafile)	❑ / ❑	■ / ■	❑ / ■	■ / ■	■ / ■
.DRW (*Micrografx*)	❑ / ❑	❑ / ❑	❑ / ❑	❑ / ❑	■ / ■
.DTP (*Interleaf*)	❑ / ❑	❑ / ❑	■ / ❑	❑ / ■	❑ / ❑
.DXF (*AutoCAD*)	■ / ❑	■ / ■*	❑ / ❑	❑ / ❑	■ / ■
.EPS (Encapsulated PostScript)†	■ / ■	■ / ■	■ / ■	❑ / ■	❑ / ■
Export with TIFF attached	■	■	■	❑	■
Export with Metafile attached	❑	❑	■	❑	❑
.GEM (*GEM Draw*)	❑ / ❑	■ / ■	❑ / ❑	❑ / ❑	■ / ■
HPGL (Hewlett-Packard Graphics Language)	❑ / ❑	■ / ■*	❑ / ■	■ / ■	❑ / ■
.PIC (Lotus)	❑ / ❑	■ / ❑	■ / ❑	■ / ❑	❑ / ■
PICT (Macintosh)	❑ / ❑	■ / ■	❑ / ❑	■ / ■	■ / ■
SCODL (Matrix)	❑	❑ / ■	■	❑	■
.WMF (Windows Metafile)	❑ / ❑	❑ / ■	■ / ■	❑ / ❑	■ / ■
Bitmapped formats (imports/exports) :					
.PCX	■ / ❑	■ / ■	■ / ■	❑ / ❑	■ / ■
.TGA (Targa)	❑ / ❑	❑ / ❑	■ / ■	❑ / ❑	❑ / ❑
TIFF (Tagged Image File Format)	■ / ❑	■ / ■	■ / ■	■ / ❑	■ / ■
User-selectable output resolution	■	■	■	■	■
User-selectable output size	■	❑	■	■	■
Exports selected objects only	❑	■	■	■	■
Clip art	■	■	■	■	■
Symbol libraries	■	❑	■	■	■
Number of clip art files and/or symbols	530	340	3,700	100	1,700
AUTOTRACING					
Black-and-white bitmaps	■	■	■	■	■
Color bitmaps	■	❑	❑	❑	■
Assigns colors to vector output	❑	N/A	N/A	N/A	■
Lets user control tracing accuracy	■	■	■	■	■
Incorporates bitmaps into final image	❑	■	■	❑	■

☞—Editor's Choice ■—Yes ❑—No

N/A—Not applicable: the product does not have this feature.

* *CorelDRAW* exports outlines only.

†Importing requires Adobe .EPS format.

CONTINUES

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ILLUSTRATION SOFTWARE: SUMMARY OF FEATURES

	Adobe Illustrator	PC CorelDRAW	Arts & Letters Graphics Editor	MASS-11 Draw	PC Micrografx Designer
COLOR PUBLISHING					
Color models supported:					
RGB	❑	❑	■	❑	■
Monochrome patterns	❑	■	■	■	■
HSB (hue/saturation/brightness)	❑	❑	■	■	■
CMY (cyan, magenta, yellow)	■	■	■	❑	❑
CMYK (cyan, magenta, yellow, black)	■	■	❑	❑	■
PMS (Pantone Matching System)	❑	■	❑	❑	Optional ($99)
Maximum number of colors supported	Unlimited	64 million	16 million	3.6 million	16.7 million
Saves color palettes	❑	❑	■	■	■
Handles process color separations	❑	■	■	❑	■
Handles spot color separations	❑	■	■	❑	■
Adds crop marks	❑	■	■	❑	■
Adds registration marks	❑	■	■	❑	■
OUTPUT PERIPHERALS					
Printers supported:					
Hewlett-Packard LaserJet II	■	■	■	■	■
Hewlett-Packard PaintJet	■	■	■	■	■
PostScript	■	■	■	■	■
PostScript (color)	■	■	■	■	■
Tektronix	❑	■	■	■	■
Xerox	❑	■	■	❑	❑
Plotters:					
Hewlett-Packard (HPGL)	❑	■	■	■	■
Vector clipping for plotter output	❑	❑	■	■	■
Film recorders:					
Agfa	■	■	■	■	■
Matrix	❑	■	■	❑	■
Polaroid Palette	❑	❑	❑	❑	❑
DOCUMENTATION					
Tutorial manual	■	❑	■	❑	■
On-disk tutorial	❑	❑	■	❑	❑
Sample files	■	■	■	■	■
Trouble-shooting guide	■	❑	❑	❑	■
MISCELLANEOUS					
Self-running installation program	■	■	■	■	■
Customizable toolbox	❑	❑	❑	❑	■
Virtual memory support	■	■	■	❑	■

PC—Editor's Choice ■—Yes ❑—No

ENDS

capabilities found in *Adobe Streamline*. The program can trace either .PCX or TIFF bitmaps and can use either a centerline or an outline approach. A dialog box allows you to customize tracing parameters, including curve length, the relative ratio of curves to lines, and noise level in pixels.

Several options unique to CorelTRACE, like edge filtering, let you achieve what are often conflicting goals in autotracing: a highly accurate trace combined with an efficiently small vector file. A batch mode, the ability to save ten customized settings, and automatic disk spooling make CorelTRACE near-perfect for the task. Unfortunately, the program does only a fair job in recognizing overlapping polygons, which means that you can expect to do extensive editing when you are tracing some detailed images.

INSTALLATION OPTIONS

The version of *CorelDRAW* we tested (1.21) works with *Microsoft Windows* 3.0, whose new memory-management capabilities result in some performance gains for memory-intensive operations. As a point of comparison, an autotracing operation that took just over a minute when the program was running under *Windows* 2.11 required only 25 seconds under *Windows* 3.0.

Unfortunately, when I upgraded from an older version of *CorelDRAW*, I found that the installation program, which otherwise worked fine, had overwritten a section of my WIN.INI file that referred to some typefaces I had previously converted using WFNBOSS. The only two options (both undesirable) were either to edit the WIN.INI file manually in order to reinsert the typeface information or to reconvert all of the outlines.

Images created in *CorelDRAW* can now be exported to a wide range of applications. *Windows* users can take advantage of the clipboard or use *Windows* Metafile (.WMF) formats. *Ventura Publisher* and *WordPerfect* aficionados find .GEM and

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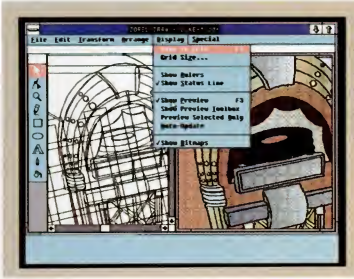

In *CorelDRAW*, you must work on your drawing in wireframe mode. You can use the F3 key to open or close the preview window, which shows you the fully rendered version of the drawing.

.WPG options next to the standard TIFF, .PCX, and .EPS exports. And the worlds of architecture, engineering, the Macintosh, and film recorders are accessible via HPGL, *AutoCAD* .DXF, *Illustrator* .AI, Mac PICT, and SCODL output, respectively.

CorelDRAW does not supply an online tutorial, but you should have no difficulty acquainting yourself with the program. *CorelDRAW* comes with a videotaped lecture and several well-written manuals that we hope will be combined into one reference document at some future date.

The most important ingredient in any illustration is, of course, imagination. But don't underestimate the importance of the artist's confidence in the toolset. In a time when programs increasingly bog down on features that most users don't need and will never use, *CorelDRAW* remains so straightforward that anyone can come to know it thoroughly. Yet it is so capable that even professional illustrators will find it difficult to exhaust its powers. For most illustrations and for any kind of type design, *CorelDRAW* is the program of this artist's choice.

—*Luisa Simone*

MASS-11 Draw

MASS-11 Draw, $695 from Microsystems Engineering Corp., has an undeserved reputation as a plain-vanilla tool for the technical illustrator. This impression is challenged by the latest version, 6.0, which incorporates a number of significant improvements over its predecessors. A wealth of new features, such as full use of VGA graphics, color PostScript output, and a fast autotracing utility make it a robust and capable product that is highly useful to artists and illustrators.

The most immediately pleasing quality of the new version is the change to a paper-white drawing surface; earlier versions used green lines on a black background. Installation has been also been simplified by a utility that prompts for the necessary directories, ports, printers, and so forth. With all its libraries and utilities, the program consumes 3MB of hard disk space, but the actual drawing program is compact enough to run from a single 720K floppy.

Instead of the ubiquitous pull-down menus, *MASS-11 Draw* places the editing menu horizontally across the top of the drawing area. Drawing tools are located in a vertical row on the left. A full selection of lines, curves, and polygons is available, and transformations such as scaling, rotating, translating, duplicating, mirroring and aligning are all supported. In most cases, these translations can either be done interactively with a mouse or by entering a numerical value from the keyboard. You can also space or distribute objects evenly along a vertical or horizontal axis—a valuable feature for technical work such as charts and diagrams.

CURVES AND CURVES

MASS-11 Draw offers two different ways to create Bezier curves. The first procedure requires you to specify the two anchor points and the two control points of the curve individually. If this sounds tricky, it is. In fact, it's an awkward way to draw a curve although with some practice, it lets you tailor curved lines to your specifications very accurately. You'll probably prefer *MASS-11 Draw*'s alternate, wonderfully intuitive technique for creating Bezier curves: the freehand spline. With this method, you simply simply draw the curve with the mouse; when you're finished, the program automatically determines the appropriate anchor and control points, which you can then use for editing the curve. I found this freehand spline function to be preferable to any other curve-creation technique.

Another nice feature is an adjustable capture distance for the mouse that allows a setting of 0 to 20 pixels. Zooms allow you six levels of magnification by multiples of two: 200 percent, 400 percent, 800 percent, and so on. You can autoscroll a selected object out of the screen area.

MASS-11 Draw offers excellent curve tools and runs well on less powerful PCs. Its lack of direct support for gradient fills requires you to create several small regions in closely related shades to simulate a gradient.

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AUTOTRACING SAVES TIME AND TALENT

By Edward Mendelson

In your computer is a high-tech drawing program that handles vector graphics with aplomb. On your desk are a few dozen pictures from your scanner. But your vector-based drawing program can't modify or edit these bitmapped images. So how can you fit the bitmapped peg into the vector hole? The answer is an autotracing program, which converts the groups of pixels that make up a bitmapped image into the manipulable "objects" that make up a vector image.

Until a few years ago you had to trace bitmapped images over by hand before you could use them in your drawing program. Then some drawing programs added tracing functions that let you select each of the separate shapes in a bitmapped image for the program to trace. Last year, *Adobe Streamline* first offered true autotracing, in which you simply tell the program the name of a bitmapped file and sit back as it traces the entire image by itself.

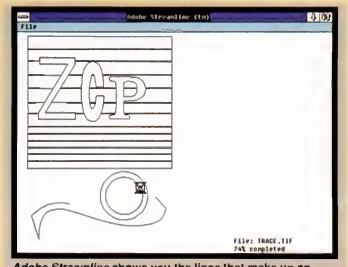
Today, many illustration programs come with full-featured autotracing programs of their own, including some that can trace color images as well as black and white. If that's the case, you won't need a standalone package; our testing showed the best of them (*Micrografx Designer* and *CorelDRAW*) to be just as good as or better than any standalone. But if your favorite drawing package does not have good autotracing, *Streamline* and its competitor, *QuickTrace*, from Mitsubishi, are quality programs that will be able to fill in the gap for you.

IT'S ALL IN THE IMAGE

Tracing works by identifying groups of pixels that form lines or outlines and translating them into mathematically defined nodes and vectors.

This isn't as easy as it sounds. In fact, you will probably have to do a considerable degree of touching up in order to retain all the details of the original. Here's why.

A bitmapped line in a scanned image is actually an irregular clump of pixels, and the tracing program has to determine the ideal centerline of that irregular clump by a process of averaging that sacrifices detail. The program has to decide whether to strip away one or more layers of possibly extraneous pixels (which might be significant detail or just "noise" introduced by the scanner) from the outer edge of the clump before averaging the remaining ones into a line that can be defined mathematically.



Adobe Streamline **shows you the lines that make up an image as they're traced, while Mitsubishi's** ***QuickTrace*** **(below) displays the bitmapped image in white, with the traced objects appearing over it in different colors.**

Prepare to make some tedious adjustments to the program's options before you get it right. You must decide which of two basic techniques the tracing program should use: the *centerline* method, which converts clumps of pixels into lines, or the *outline* method, which converts them into outlines. With most images, the choice between the two is clear. But some images require a delicate combination of the two methods, with clumps of pixels below a certain width converted into lines and clumps larger than that width converted into outlines.

Autotracing programs aren't perfect, but they work well enough to be a real help sometimes. They allow relatively unskilled users to include the kind of graphics into their presentations and desktop publications that could otherwise be produced only by skilled artists. If you need the images and can't draw them yourself, the time you spend adjusting the options for best results will be far outweighed by the time you save.

Adobe Streamline

Adobe Systems' $395 *Adobe Streamline* was the first autotracing program that let you select an image and sit back while the program did all the dirty work of tracing it for you. Even with the increased competition from *QuickTrace* and the autotracing functions available in full-scale drawing packages, *Streamline* continues to hold its own as one of the most impressive performers in the field, although a somewhat pricey one. Since *Streamline* runs under *Windows*, you can easily switch back and forth between *Streamline* and *Windows*-based drawing programs such as *CorelDRAW*, *Micrografx Designer*,

and *Adobe Illustrator*—the three programs to which it exports directly. The latest versions of *CorelDRAW* and *Micrografx Designer* already have excellent autotracing functions of their own, so if you use these, you don't need *Streamline*. But if you're using *Adobe Illustrator*, or working with files created by a very-high-resolution scanner, or simply converting bitmapped images to vector-based .EPS, *Streamline* may be just what you need.

Few *Windows* applications are as straightforward to use as *Streamline*. You select one or more .PCX, TIFF, or *MacPaint* files from a menu, and the program does the rest. The screen shows the progress of the tracing by drawing the converted image as you watch, and also by reporting the percentage of completion. You can modify tracing and export options for individual files or set permanent defaults that apply to all the files in the batch. If you don't have enough expanded memory to convert a large image, or if you want only part of a scanned image, you can limit the conversion to a rectangular block, which you select with the mouse.

HIGHLY TUNABLE

Streamline offers the two basic conversion methods, outline and centerline, plus a combined method that uses outline conversion for bitmapped regions above a specified thickness and centerline conversion for thinner regions. Options for outline conversion include setting the "noise" level, which tells the program whether to trace or ignore stray pixels. Options for centerline conversion include the number of pixels that the program strips from bitmapped lines before finding the average center of a line. You can also choose to convert white lines on a black background instead of the usual black on white.

All three conversion methods can be fine-tuned to adjust the degree to which the converted image will match the fine details of the bitmap. You can also adjust the output so that it better reflects images that consist mostly of long straight lines or short curved ones. You can choose to convert images only into straight lines or only into curves. You can't select fill patterns, though you can do this in your drawing program.

With irregular outlines, *Streamline* does a superb job. It sometimes has slight difficulties making parallel lines come out parallel, and you'll probably have to work to get the combination outline and centerline method to produce manageable output. But if you're looking for an elegant, *Windows*-based program for autotracing alone, make a beeline for *Streamline*.

QuickTrace

Mitsubishi's $245 *QuickTrace* is high in speed and power, low in cost and RAM requirements, and middling in the quality of its user interface. Like other autotracing programs, it lets you choose a scanned bitmap image and modify a few options while the program does the conversion.

Unlike *Streamline*, *QuickTrace* uses DOS's 640K and nothing more; it doesn't use *Windows* or *GEM* or any other graphics-based interface. Within these limits, the designers of *QuickTrace* evidently worked to rival *Streamline* and generally succeeded. Conversions tend to be faster than *Streamline*'s, with equal or marginally superior results in PC Labs' tests. As in *Streamline*, some parallel lines come out less than parallel, but the effect is slight and infrequent. *QuickTrace* lets you convert only TIFF files, not .PCX, and, unlike *Streamline* and the best drawing programs, doesn't let you select part of an image to trace.

Besides the standard outline and centerline tracing methods, *QuickTrace* offers a method that it calls "coloring" because the results vaguely resemble a child's coloring book. Imagine a flag divided into three panels, with the left and right panels shaded black and the middle one unshaded. With this kind of image, the outline method generates a trace with only two objects: an outer, shaded one that corresponds to the two original outer panels and the connecting lines above and below the central unshaded panel; and an inner, unshaded object that corresponds to the original center panel. But the "coloring" method creates three separate boxes corresponding to the original three panels, so later manipulation is far easier.

MANY OPTIONS

QuickTrace gives you a range of options for thinning thick lines and setting line widths, color and fill patterns, arc formats, and other details. As the program processes an image, it displays different colored lines to indicate the kinds of curves being converted. (You lose this feature with VGA monochrome.)

QuickTrace exports to .EPS, .CGM, and Micrografx .DRW formats. You can create .EPS files in standard or *Adobe Illustrator* format, or with an added DOS header and TIFF image for previewing. Options for .CGM files tailor the output for the ANSI standard, or for *Freelance Plus*, *PageMaker*, *Ventura*, or *WordPerfect*. You can also export to *Harvard Graphics*, but because of the limitations of that program, the resulting image will use only straight lines.

When buying *QuickTrace*, you must choose between three versions: the $245 version for desktop publishing (the one we tested), the original $245 version that exports only to *Freelance*, or the $295 version for output to *AutoCAD*.

The clunkiest part of *QuickTrace* is its interface, which makes you specify drives by pressing the Ins key and doesn't give you any first-letter shortcuts for navigating its menus. If you can live with these trivial inconveniences, you'll find that *QuickTrace*'s speed and accuracy are well worth its modest price.

Adobe Streamline
Adobe Systems Inc., 1585 Charleston Rd., P.O. Box 7900, Mountain View, CA 94039-7900; (800) 344-8335.
List Price: $395
Requires: 640K RAM (expanded memory required for images larger than 20 square inches), hard disk, *Microsoft Windows* 2.03 or later; DOS 3.1 or later.

CIRCLE **406** ON READER SERVICE CARD

QuickTrace
Mitsubishi International Corp., Technology Affairs Dept., 520 Madison Ave., New York, NY 10022; (212) 605-2339.
List Price: DTP version, $245; *Freelance* version, $245; *AutoCAD* (.DXF) version, $295.
Requires: 640K RAM, DOS 2.1 or later.

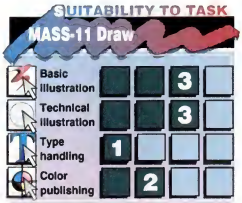
CIRCLE **407** ON READER SERVICE CARD

I have one quibble concerning the drawing menu: probably the two most frequently used choices are the pencil icon for drawing and the hand/finger used for selecting elements. These icons are selected from an icon box shared by four icons. To choose the icon you want, you must cycle through the other three. I'd prefer each of these tools to have its own box for easier access.

The overall responsiveness of the program is very good. On our test machine (a 25-MHz 386) *MASS-11 Draw*'s redraws were very swift, but its performance was entirely acceptable even on a 10-MHz 286-based computer. Microsystems Engineering says that the program supports extended memory, though this feature was not fully documented.

NOW APPEARING IN COLOR

MASS-11 Draw now supports on-screen color as well as color output. It uses a rather unusual color system. To create a color, you specify its hue, saturation, and brightness; but while saturation and brightness can be selected in percentage increments, the hue must be chosen in one-degree increments from a total of 360. The VGA and EGA screen drivers that come with the program support only 16 colors; all other colors are generated by dithering. You can save individual palettes for later use.



Patterns and lines can be drawn in color or black and white. Black-and-white patterns can be specified in one-percent increments of shading, and you can choose a variety of hatching patterns in addition to the default half-tone patterns. Unfortunately, graduated patterns are not available—a lack that proved bothersome in the jukebox test illustration, which relies heavily on graduated pattern fills. To substitute, it was necessary to subdivide sections manually and choose incremental percentages of color to approximate the graduated patterns.

Color output can be sent to PostScript and HP PaintJet printers. Our color test illustration produced excellent results on a QMS color printer, and all the monochrome output to laser printers was of high quality. A nice feature is the QuickPrint command: you simply select the area of interest with the mouse, click, and it's printed.

TEXT EDITING

MASS-11 Draw's text-editing features are acceptable if your work doesn't depend on them. Point size, track, and width are selectable. WYSIWYG characters are drawn as vectors on the screen, but a menu selection allows them to be previewed in their printed form. Paragraphs can contain as many as 100 lines, with 200 characters on each line. Once you enter your text, you can move it freely as well as select text color and fill patterns.

MASS-11 Draw is weak in font selec-

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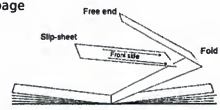

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Slice the folded edge

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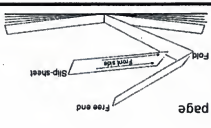

1. Follow instructions on the other side

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Requested Line of Credit $ _____

Your Name _____ First _____ Initial _____ Last **Date of Birth** _____ Mo. Day Yr.

Present Address _____ Street _____ Apt. # _____ City _____ State _____ Zip

Social Security Number _____ ( ) _____ Home Phone

Date of Residence _____ Month Year **Monthly Payment $** _____ ☐ Buy ☐ Rent ☐ Other

Previous Address _____

Dates of Residence _____ From _____ To

Your Employer _____
(If self-employed, see rear panel.)

Date of Employment _____ Mo. _____ Yr. **Position** _____

Monthly Income _____ Gross $ _____ Net $

Employer's Address _____ Street

( ) _____ City _____ State _____ Zip _____ Business Phone

Previous Employer _____ **Address** _____

Dates of Employment _____ From _____ To

Other Income _____ I have received since (Date)_____
Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as a basis for repaying this obligation.

Monthly Income _____ Gross $ _____ Net $

Name and Address of Nearest Relative Not Living With You _____

_____ Relationship _____

b. Credit Information

Include joint information, if joint account requested.

Bank Account _____ Bank Name ☐ Checking ☐ Savings

Address _____

Bank Account _____ Bank Name ☐ Checking ☐ Savings

Address _____

Bank Loan Reference _____ Bank Name _____ Address

_____ Payment _____ Balance _____

Bank Card Reference _____ Bank Name _____ Address

_____ ☐ VISA ☐ Mastercard Payment _____ Balance _____

(please check appropriate box):

☐ **Joint Credit** with another person. Complete all information.
☐ **Individual Credit** but rely on income or assets of another person as a basis for repaying the credit requested. Complete all information
☐ **Individual Credit** Complete sections "a" and "b" only.

Please complete all appropriate sections, *providing at least two years' residence and employment history.* This will enable your information to be processed as quickly as possible. If you are self-employed, please be sure to complete section "d" below.

Other Credit Card Reference _____ Bank Name _____ Address

_____ Payment _____ Balance _____

Other Credit References _____ Payment _____ Balance _____

Account No. _____ Expires _____

Driver's License No. _____ State _____ Expires _____

c. Joint Personal Information

Joint Name _____ First _____ Initial _____ Last

Date of Birth _____ Mo. Day Yr. **Social Security Number** _____

Address _____ Street _____ Apt. #

_____ City _____ State _____ Zip

Date of Residence _____ Mo. Yr. **Home Phone** ( ) _____

Employer _____

Date of Employment _____ Mo. Yr. **Position** _____

Monthly Income _____ Gross $ _____ Net $

Employer's Address _____ Street

_____ City _____ State _____ Zip ( ) _____ Business Phone

d. Self-Employed Information

Complete this section only if you are self employed.

Business Name _____

Business Address _____

☐ Proprietorship ☐ Corporation ☐ Partnership **Business Phone** ( ) _____

Description of Business _____

Your Position _____ **In Business Since** _____

Your annual income from business _____ **Business' annual income** _____ (gross) _____ (net)

You must provide at least one of the following:

1. Business Bank _____

( ) _____ Telephone _____ Personal Banker's Name

2. Accountant's Name _____

( ) _____ Telephone

3. Financial statement on business attached.

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CIRCLE 115 ON READER SERVICE CARD

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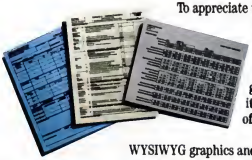

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MICROSOFT WINDOWS.

CIRCLE 257 ON READER SERVICE CARD

Call (800) 267-9976 (US only) or (613) 594-3026. Indigo Software Ltd., 560 Rochester Street, Suite 400, Ottawa, Canada K1S 5K2

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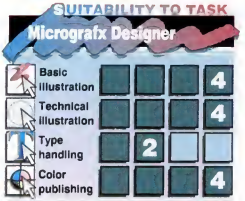

.PIC, .WMF, .DRW, and .EPS, and it can incorporate color bitmaps into your drawings. *AutoCAD* .DXF files are easily imported and translated automatically. The program comes with a large clip-art library that includes hundreds of images, and customized clip-art collections are available. Micrografx also offers custom clip-art service to convert trademarks and logos into resolution-independent outlines that can be output at higher quality than scanned versions.

But it's the program's accurate and easy-to-use autotracing feature that is the most spectacular. The tracing options let you choose the line type (Bezier curves or polygonal lines), the number of points in the lines (fine, average, and coarse), and the smoothness or degree of corner curvature. Tracing complex images takes a long time and uses lots of memory, especially in "fine" mode, but the results are worth the wait; our complex jukebox image required little cleanup work after tracing.

FACT FILE
EDITOR'S CHOICE

***Micrografx Designer*, Version 3.0**
Micrografx Inc., 1303 Arapaho Rd., Richardson, TX 75081; (214) 234-1769, (800) 733-3729.
List Price: $695
Requires: IBM AT, PS/2, or compatibles; 1MB RAM; hard disk; EGA or VGA graphics adapter; mouse; *Microsoft Windows* 2.0 or later
In Short: *Micrografx Designer* 3.0 is a powerful drawing package for the sophisticated artist. Its large number of tools make it difficult to master but offer the flexibility to do just about anything well. Type handling has been noticeably improved, and the new version offers enhanced color support, a large clip-art library, and a superb autotracing facility as well.

CIRCLE **405** ON READER SERVICE CARD

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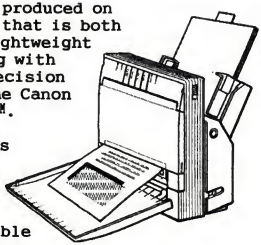
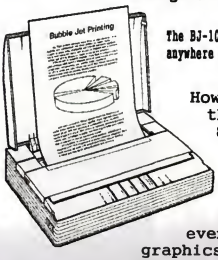
CIRCLE 133 ON READER SERVICE CARD

This document was produced on the first printer that is both a desktop and a lightweight portable, printing with letter quality precision on plain paper. The Canon BJ-10e Bubble Jet TM.



The BJ-10e with its optional 30-sheet feeder printing on a desk.

On a desk, with its optional 30-sheet paper feeder, it's an ideal personal printer. As a single-sheet portable with its optional rechargeable battery pack, it weighs a remarkable 4.6 pounds and prints on a variety of paper. The BJ-10e emulates the IBM[R] Proprinter TM X24E, so you can use a wide range of applications software.



The BJ-10e printing a single sheet anywhere you want.

How fast is it? It printed this page on ordinary 8 1/2"x11" paper at 83 characters per second. It won't slow down when printing in bold or various type sizes either. It even handles complicated graphics, as you see in these scanned-in BJ-10e illustrations.

What's more, its blacks are intensely black and its ink dries instantly, so it never smears.

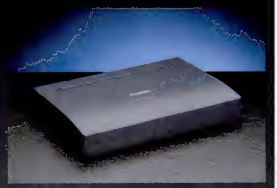
Another page in printer history.

How quiet is it? Quiet enough to be used in the middle of the night with someone asleep a few feet away.

And, you never have to worry about maintenance because it uses a pop-in BJ cartridge which contains the print head and the ink supply. Every cartridge prints approximately 700,000 characters (HQ mode), making it as economical to use as it is to buy.

But best of all, the BJ-10e works everywhere you could possibly need it, fitting neatly into a briefcase with its optional rechargeable battery pack.

The Canon BJ-10e Bubble Jet. What other printers print on a desk, it prints anywhere.



Canon BUBBLE JET PRINTER **BJ-10e**

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ACTUAL SIZE

BUBBLE JET

CIRCLE 155 ON READER SERVICE CARD

The document displayed in the BJ-10e is actual output from Adobe® PageMaker® software using the IBM Proprinter X24E printer driver.

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Designer can even trace color bitmaps and assign colors to a vector output, though the results are not as good as with black-and-white files. Bitmaps can also be incorporated into the final image.

24-BIT COLORS

Micrografx Designer now supports 24-bit color internally, making it extremely powerful in the area of palette management. Palettes can be saved separately and are fully editable in either the RGB, HSB (hue/saturation/brightness), and CMYK color models. Printing color separations in both process and spot color modes is also surprisingly easy. *Designer* can simulate (with fairly pleasing dithering techniques) up to 16.7 million colors on the screen. For those considering a move to *Microsoft Windows* 3.0, which supports 16 colors on standard VGA or up to 256 colors on a Video Seven VRAM card, a compatible version identical in function to the one that we tested (*Designer* 3.01) will be available shortly after this issue reaches you.

For putting your artwork on film, Micrografx includes a listing of Authorized Imaging Centers that can turn *Designer* files into full-color slides and even offers a telecommunications utility to transmit files electronically from within *Designer*. The program also supports SCODL output if you prefer to use your own film recorder. An intriguing feature for presentations is *Designer*'s ability to create on-screen "slide shows" for demonstrations—normally the province of presentation graphics software.

Micrografx Designer is a robust and powerful program whose rich complexity will appeal those who need power and sophistication in graphics. Mastering the product's advanced features requires real dedication, but if you're willing to invest the time, *Designer* will do just about anything you need.

—*Isaac Victor Kerlow* ■

If you're willing to invest the time to master its advanced features, *Micrografx Designer* will do just about anything you need.

Luisa Simone and Edward Mendelson are contributing editors of PC Magazine. *Isaac Victor Kerlow is the chairman of the computer graphics department at Pratt Institute in Brooklyn, New York. Mark Wilson is a West Cornwall, Connecticut–based artist who specializes in computer-generated fine art. Maureen Jones is a New York-based medical and technical illustrator who has taught at Pratt Institute and at the School of Visual Arts in New York City. Gerard Kunkel is the Director of Design and Electronic Publishing at* PC Magazine.

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CIRCLE 483 ON READER SERVICE CARD

256 Color Graphics Doesn't Have To Cost A Lot.

Make childs play out of high resolution color graphics with Trident's new TVGA 8916 series VGA boards. With 256 colors in all high resolution modes, faster graphics processing speed, and a flicker-free monitor refresh rate, an 8916 board can help make anybody look good.

More Colorful Hi Res Drivers

Of the 45 boards listed in PC World's (May 1990) Buyers Guide on Super-VGA Boards, only Trident's 8916-8 gives you 256 colors in 1024 x 768 resolution for Windows 3.0, Presentation Manager, AutoCAD, Ventura, and GEM. We also support most of your other favorite applications, some great new rookies, and 8514/A emulation.

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LAN TIMES READERS CHOICE

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CIRCLE 281 ON READER SERVICE CARD

BUILDING WORKGROUP SOLUTIONS

LAN Metering Software

Keeping track of network application use to fight software piracy is a necessary evil for any organization. These 11 products also ensure the smooth growth of your LAN as the demand on resources rises.

BY KIMBERLY MAXWELL

GRAPHIC ILLUSTRATION: GARY W. KAPLOW

From parking and electrical meters to speedometers and other automobile gauges, our lives are full of metering and measuring tools that regulate and report our activity. Not all of this measurement may be desirable, but you can't say it isn't occasionally necessary.

Local area networks are hardly immune from the need for metering. LAN metering programs help network administrators audit your network activity, regulating the number of users legally accessing networked programs and establishing better security in the process. They provide you with important information about how the network and networked applications are used.

WHY METER APPLICATIONS?

Marketing a networked application is a challenging task. The technology of file sharing isn't a problem anymore—a veteran of a one-semester programming course knows how to write applications that can allow simultaneous multiple access to the same data file. The real threat to the survival of many software companies is not technological but economical. It is LAN piracy.

Piracy takes two forms: blatant and subtle. Blatant piracy takes place when someone copies a program from the LAN file server onto one or more floppy disks and walks out the door. On a more continual basis, however, LANs are the scene of subtle piracy. When a network administrator buys a single-user copy of a spreadsheet and lets 12 people access the program simultaneously, the company selling that product has been pirated out of a lot of money. Software companies have taken legal action against large corporate LAN pirates, although most cases are settled out of court.

Some software companies try to ignore networks and offer no site-licensing agreements. In other words, if you legally want to use their package on multiple PCs, you need to purchase multiple copies of the program. This marketing practice has led, particularly in the case of several federal government computer contracts, to organizations' maintaining closets full of shrink-wrapped packages—one for each potential user. In the meantime, one copy of the program is shared on the network.

Other program vendors, notably Ashton-Tate, fought the LAN piracy threat with techniques such as internal counters that locked out attempts to use more than the authorized number of copies and "bump disks" that increased the number of legal users. Network administrators hated these restrictions for good reason: they ran afoul of legitimate backups and server restorations.

Fortunately, most vendors of applications that can run on networks today have site-licensing agreements available. No one has a perfect solution, so the most common licensing agreement is on a "per server" basis. Only the most novice or corrupt administrator would violate this type of license. But there's a downside here, too—per-server site licenses are expensive for small LANs. In fact, many administrators find that buying enough single-copy versions of the program to meet peak demand is still the best alternative.

Smart network managers also know that it usually isn't economical to have a separate copy of an application program for every person on the network. Seldom does everyone need to use any one particular application at the same time. Capable network planners and administrators attempt to buy enough copies of an application to meet a peak demand. The problem remains, however, that demands have a way of changing. That's where metering software comes in.

Large organizations and independent auditing firms wisely tend to include software licensing on their internal audit checklists. If the application being audited is being misused, there's a potential hazard of fines and discredit for the accused company. These license abuse problems should never arise through the audit and control measures established through metering software.

MEETING OBLIGATIONS

To help LAN administrators meet their obligations, the products evaluated in this review keep track of the number of applications in use. Some of the products can prevent anyone above a preset number of people from using a particular program at one time, sending a message to the user who's trying to exceed the limit. Although these programs do their best to buffer the negative impact of denying access, being locked out of an application usually makes people unhappy. They tend to take out their unhappiness on the LAN administrator.

Other products reviewed here only audit and report on use; they don't lock people out. The reports show when the demand exceeds the legal supply (and how often), and you can act to correct the situation before it becomes a serious problem. You can also improve the overall security of the network and compile statistical data.

The products we reviewed vary in price from $96 (for the Aldridge Company's *PreCursor*) to $795 (for Certus International's *Certus LAN* 2.0 and McCarty Associates' *WorkStation Manager*) and up depending on the number of applications and workstations on your network. They also vary in functionality. You can choose a simple package that reports LAN usage, menuing programs that control applications from behind customized screens, and auditing packages that create extensive reports on every type of network activity. All of these different types of programs give

METERING SOFTWARE: SUITABILITY TO TASK

When it comes to metering software, products are available to suit a LAN administrator's every need. Choosing among the 11 products reviewed, however, is no easy task because of the diversity among the products' functions. The informed subjective ratings that follow can help you in your selection. Compare them with the product reviews and the features table for a complete picture of what each product offers.

THE TASKS

Each metering product is rated according to its usefulness in four areas. The first rating, **Limit Access**, covers a product's ability to limit the number of people able to access an application at any one time. Some products only report on excessive use; others lock out users beyond a certain specified point and may include features to invite previously rejected users to enter an application once an "opening" arises.

Auditing how individuals use network resources is important to many administrators, hence our second rating of **Individual Audit**. Some packages provide auditing actions by individual user; others focus more on files and applications, earning them a high rating in our third category, **Application Audit**. The third rating more than any demonstrates the product's ability to show the LAN administrator how resources are used. This affords the time to plan for growth and justify future investments.

Some packages do more to establish or enhance LAN security than others, as reflected in ratings for our fourth category, **Security**. Virus protection and control of users' running and copying applications are among many programs' strong features.

0—Completely unsuitable
1—Poor
2—Good
3—Very good
4—Excellent for the task

you efficient control over your applications.

Most metering products use a TSR program to control or monitor how each workstation uses applications. All metering programs work well in networks running a file server-oriented operating system like Novell's *NetWare*, Banyan's *VINES*, or *Microsoft LAN Manager*. These LAN operating systems, in fact, can initiate the metering software from a protected script. Some metering programs run in the Novell or Banyan server and work from there. However, they can use up to 500K of server RAM.

In DOS-based networks, it's more difficult to ensure that the metering software takes full control because it runs from DOS batch or AUTOEXEC.BAT files. Determined pirates, after all, can circumvent batch files. In a sloppy network where everyone has the right to create directories and files, the metering program is of little value because anyone can copy an application to a different directory. This is one way of bypassing site licenses.

PRODUCTS REVIEWED

While the products PC LAN Labs has reviewed differ in various ways, the design criterion they share is LAN metering. We tested metering products capable of limiting the number of simultaneous users on the network along with those giving reports on application and network usage. Some programs have both features. Some packages have additional capabilities, such as Brightwork Development's *SiteLock* and *Certus LAN* 2.0, for identifying corrupt executable programs that may indicate viruses on your network.

Several applications only work with Novell *NetWare* including the newer *NetWare 386*. Others support *NetWare* along with a range of other network operating systems. As you'll see in our summary of features, packages that work with *NetWare* often can act as NLM (*NetWare* Loadable Module, for *NetWare 386*) or VAP (Value Added Process) programs—for earlier versions of *NetWare*—that run in the server.

We reviewed 11 products including those supporting only *NetWare* networks. The *NetWare* metering applications are Network Management's *LANtrail*, Blue Lance's *LT Auditor*, *SiteLock*, *WorkStation Manager*, and Triticom's *ARGUS/n*. The programs supporting a host of other network operating systems in addition to *NetWare* are LANSystems' *LANShell*, *PreCursor*, *Certus LAN*, Saber Software's *Saber Meter*, Connect Computer's *Turnstyle*, and NETinc.'s *NetMenu*.

A menuing system is a more secure metering program for your LAN. Four programs—*NetMenu*, *WorkStation Manager*, *PreCursor*, and (to a lesser extent) *LANShell*—are menuing tools that allow you to limit the number of simultaneous users for each application during the menu setup process. *WorkStation Manager* adds to this capability in a number of impressive ways, as you'll see in the product's review.

If you want a metering application that only gives you reports on your application and network usage, *LANtrail* is a simple product to install and operate. Most other products we reviewed can limit the number of users for each application and report on network and application usage.

A FULL PICTURE

Because metering programs give you a full picture of who uses what resources when, they provide great support for budget requests and operations reports. You can impress the bean counters by producing professional-looking reports from most of these programs. Add a few month-to-month statistics, put them on an overhead chart, and you'll never have to worry about your budget requests being approved.

Chances are, that above all, you want to do the right thing: to maintain proper LAN application use. These tools let you do what's right and be economical in doing so. By preventing software license abuse and piracy, you prevent harm to your organization and improve management.

EDITOR'S CHOICE

- SiteLock
- Turnstyle

Despite the great diversity in LAN metering programs, two stand out enough to deserve *PC Magazine*'s Editor's Choice awards: Connect Computer's *Turnstyle* and Brightwork Development's *SiteLock*. *Turnstyle* is a simple-to-operate, menu-driven metering tool that LAN administrators can use on a variety of networks. It locks out anyone trying to use an application above the designated maximum user number. Finally, it creates its reports in a database format familiar to most administrators.

SiteLock is a tight security metering program for use on Novell *NetWare* networks only. We found it very strict in locking out and preventing access to an application once it meets the user limitations. Similar to *Turnstyle*, *SiteLock* gives reports in database form. However, *SiteLock*'s ability to run as a VAP or NLM puts the control at the server and limits the impact at the workstations.

An honorable mention goes to Network Management's *LANtrail*. While this product doesn't actually limit the number of users for an application, it does provide detailed reports of each application's use so you can make your own determination of licensing abuse. *LANtrail* runs as an NLM under *NetWare 386*, so network administrators with newer systems can gather informative data.

All the products mentioned here are true to the word "metering," providing reports and well-defined statistics on application and network use. You'll find them helpful in metering and monitoring LAN activity, making management a breeze rather than a chore.

TRITICOM

ARGUS/n

by Gaylan W. King

ARGUS/n from Triticom is intended for use by system managers to monitor system software use and hardware configuration. It does not turn away application users, but it handily records and reports the pertinent usage data. At a cost of $245 per server, *ARGUS/n* offers a respectable value.

The program is a distributed application consisting of two different software elements. A program named ARGUS is the system monitoring component. The system manager executes ARGUS to observe or record workstation activity, or to conduct a hardware inventory of the entire LAN. The second program is ARGUSeye. One copy of ARGUSeye executes in each LAN workstation as a TSR program occupying less than 4K of memory. It reports to

FACT FILE

ARGUS/n
Triticom, P.O. Box 11536, St. Paul, MN 55111; (612) 937-0772.
List Price: $245 per server. Licensing also available per site or corporation.
Requires: DOS 3.1 or later, Novell *Advanced NetWare 286*, Version 2.1, or *NetWare 386*, 4K RAM per workstation.
In Short: *ARGUS/n* records software usage, workstation activity, and monitors system configuration status in a practical, no-frills package. A handy tool for system managers and those concerned with organizational software strategy and justification, time management, or billing.

CIRCLE **604** ON READER SERVICE CARD

ARGUS the hardware configuration and software activity in as many as 250 workstations per LAN.

ARGUS/n works with any PC/MS-DOS computer, and requires PC/MS-DOS 3.1 or higher. It occupies 400K of RAM when loaded.

INSTALLATION PROCESS

ARGUS/n's installation process is simple, but it can take a long time on a big LAN. Installation requires the revision of multiple log-in scripts and/or AUTOEXEC .BAT files. Triticom recommends simply running ARGUS from a network drive and limiting access to the system manager and privileged users. The ARGUSeye installation is a bit more involved. Triticom recommends copying ARGUSEYE.EXE to the SYS:LOGIN directory of each server to make it readily accessible during *NetWare* initialization.

In order to initialize network communications, you must execute ARGUSeye as soon as both IPX and NET3 are initialized and you've changed to the network drive containing the SYS:LOGIN files. The sequence of commands would look like:

```
IPX
NET3
F:
ARGUSeye
LOGIN
```

The ARGUS program is a hierarchical set of menus and data display screens, very similar to *NetWare* utilities. It employs the concept of station address—in other words, ARGUS identifies each LAN workstation by its physical network address, a unique numeric identifier such as 02608CA1111F. ARGUS allows you to associate this number with an alphanumeric name, such as "Fred" or "Accounting."

A Station Detail Menu leads to the Station Current Activity Display, a list of programs currently executing at each workstation. The most recently executed program, start date and time, and number of keystrokes are listed at the top of the screen. The next most recently executed programs (to a limit of ten) are listed below.

SUITABILITY TO TASK
ARGUS/n

A similar list, the Station Recent Activity Display, provides detailed information about the last ten programs that were both executed and terminated at a specific workstation. The Station Detail Menu also allows the user to query each workstation for hardware configuration data.

Triticom is a small company with a good idea that became *ARGUS/n*. Its address is a post office box, yet its representatives provided timely phone responses that included technical help from the engineers who wrote the program. *ARGUS/n* itself gives a simple yet strong showing; it does just what it says it will do. Triticom bears watching to see if a small, bright company can still find success in an industry dominated by megabuck giants.

CERTUS INTERNATIONAL CORP.

Certus LAN

by Gaylan W. King

At a cost of $795 for a server and ten nodes and $380 for each additional five nodes, *Certus LAN 2.0* does not fall into the category of low-priced software. It does, however, fall into the category of competent, well-designed software that is worth every penny of its price.

The heart of *Certus LAN* is a large on-line database that keeps track of all the files on your server—along with typical definitive information—and compares the data it finds with what it gathered earlier. It alerts the network administrator when changes fall outside of specific criteria.

On the workstation end, a program called CERTUS.DAT controls user actions on the LAN. The program takes an electronic snapshot of the code size, date/time stamp, and other information. Each time you use a program, it is compared against the database for any change.

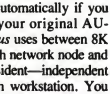
As part of its job, *Certus* also provides memory-resident, automatic virus scanning. It recognizes known viruses and detects patterns of any suspicious changes in program code.

STARTING OFF SLOW

Certus International recommends your initial load be to a local hard drive—not the file server. After operating the program enough to gain some comfort with it, load it to the server for easier access to all LAN nodes. At that point, you can implement the desired control element by editing individual log-in scripts to match the chosen user profile.

Certus is easy to install, and its instructions are well written. (Note that at least 1MB of free space must be available on the server's hard disk.) During installation, you choose whether or not *Certus* can add seven lines to the beginning of your AUTOEXEC.BAT. Otherwise, you execute the program via the CERTUS.BAT file that will be created automatically if you choose not to alter your original AUTOEXEC.BAT. *Certus* uses between 8K and 12K RAM on each network node and operates memory-resident—independent of the server—at each workstation. You

FACT FILE



Certus LAN 2.0
Certus International Corp., 13110 Shaker Square, Cleveland, OH 44120; (800) 722-8737, (216) 752-8181.
List Price: $795 per file server and first ten nodes. Additional nodes cost $380 for each five.
Requires: DOS 3.1 or later; Novell, IBM, 3Com, Banyan, or any DOS-based LAN operating system; 8 to 12K RAM on every networked PC.
In Short: An excellent, transparent LAN management and control utilities program, providing virus protection, security, and disaster recovery.

CIRCLE **605** ON READER SERVICE CARD

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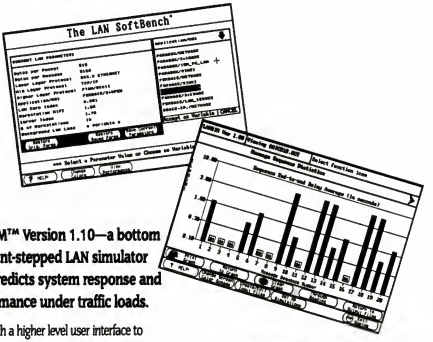

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CIRCLE 309 ON READER SERVICE CARD

make changes to default settings as you become accustomed to the program and better able to draw upon its powerful utilities.

Once installed, *Certus* captures elements of every file on the targeted drives, plus machine-specific operating system, boot-track and partition information, FAT and directory structure, and CMOS specifications. The initial read can take hours on a large network. From this information, the software creates what the manual calls a "critical disk." You guard this disk to help you later recover from any hard disk failure or accidental disk format.

After installation and a reboot, *Certus* works in the background. If you select

Windows Enabled at installation, a window will flash verification of each function selected. The excellent documentation leads you through the various utilities, including isolation of a virus should you encounter one. Another example is a utility named BOOTLOCK, which protects hard disk-equipped computers from entry by being booted from the A: drive.

LOGGING USER ACTIVITY

Certus records every user logged onto the network, including time spent in each program on the LAN. Its Usage Logs also list whether or not a program was allowed to run. *Certus* denies further use of a program if it detects altered program code, until told it is safe.

By maintaining an authorized software list, you control the software available to each node. *Certus* will not recognize unauthorized software, so users cannot load packages that *Certus* doesn't know about. This decreases the possibility of having mongrel software or a virus on the network.

You control the capability to write to and from floppy disks by allowing activation of program-file DOS attributes. *Certus* allows you to copy data files while protecting the actual program files.

The small amount of time required to run the automatic signature check is the only sign of *Certus*'s presence. Otherwise, you soon forget the program is in residence. The best security is the least obtrusive security; "certus," Latin for certainty, is representative of this.

If you live in fear of network intrusion, data theft, or program pollution, take a close look at *Certus LAN*. Its impressive list of services and utilities might make your day.

LANSYSTEMS INC.

LANShell

by Kimberly Maxwell

LANSystems' *LANShell* isn't a seedy shell game; it's a complete menu system you can customize to your own network's needs. All LAN managers, after all, need additional flexibility to customize limitations on network use. You get this flexibility from *LANShell*, a program allowing fast access to network resources.

The software requires a low 9K RAM in every workstation with *LANShell* loaded. The $495 price includes a one-server site license with unlimited users, but if you need *LANShell* for more than one server, plan on paying the same price for each.

LANShell is compatible with any DOS-based network, including some larger ones like Novell *NetWare*, IBM *PC LAN*, 3Com *3+*, and Banyan *VINES*. It doesn't matter which network operating system you use; *LANShell* provides a uniform environment for network users.

Installation consists of copying *LANShell* directories and files onto a selected network drive. You or your network administrator must copy all application files to an appropriate subdirectory; this allows users to select resources through a simple main menu. The detailed manual deftly leads you through tutorials for creating and designing a menu and operating the menu systems.

CREATING MENUS

While you may find creating *LANShell* menus to be difficult, several helpful tools are available to change your mind. There are pull-down menus with graphic selections and a screen painter to help you create screens. With LANShell, you create pop-up screen displays or selection windows, pull-down sub-menus, entry forms, and on-line help screens. You can even require password security in some instances.

FACT FILE

PC MAGAZINE

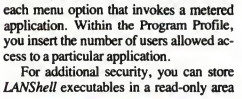
LANShell
LANSystems Inc., 300 Park Avenue South, New York, NY 10010; (800) 458-5267.
List Price: $495 per server.
Requires: DOS 3.0 or later, any network operating system, 9K per workstation.
In Short: *LANShell* helps you create menus and menu systems, designing them to meet your own specifications and measuring the number of users for a networked application.

CIRCLE 606 ON READER SERVICE CARD

The program creates special graphic borders—using any combination of text and graphics available from the IBM extended character set—and position windows within the screen's display. After completing your menu system, you may edit or delete any options with simple commands.

LANShell's software license metering feature controls simultaneous users based on the number of licenses you purchased for a particular application. The LANLOCK metering command easily helps you set such simultaneous user limits on specific applications. You create a Program Profile for each application you want to meter, then edit the command form for each menu option that invokes a metered application. Within the Program Profile, you insert the number of users allowed access to a particular application.

For additional security, you can store *LANShell* executables in a read-only area



or change the file extensions. This helps prevent illegal copying or changing of executable files on the network. Changing filename extensions also makes it difficult for users to copy applications from the network.

LANShell also provides you with several unexpected utilities. You can store menus and screens in a catalog; each catalog constitutes a menu system. There is also a Catalog Chart utility to document the menus and forms for a given catalog.

Overall, *LANShell* is a solid menuing

We wanted to compare TOPS DOS BUNDLE to NetWare but we didn't have enough time to install it.

At Sitka* we have a practical philosophy regarding PC networks: to maximize day-to-day performance on your PC, a network has to be easy to install, easy to use, and maintenance free. Sounds logical, right?

Well, with NetWare you get 32 disks and 21 manuals. You'll also need a separate server and hours of training. Not to mention the time and expense it will take just to get it up and running.

But with TOPS Network Bundle for DOS, you'll be sharing files and peripherals over a true peer-to-peer network. Just by using a few familiar DOS commands. And all while operating at Ethernet speeds.

Got a minute?

With just six disks per PC, you can install TOPS DOS Bundle in less than a half hour. Without a network administrator or a costly dedicated server. Its streamlined menus let you choose only the network functions you need.

TOPS DOS Bundle saves more than time, it saves space. As Michael Goodwin of *PC World* put it, the TOPS DOS Bundle "leaves a full 537K of usable workstation RAM—more than enough to run memory-hogging applications."

And, unlike NetWare, TOPS DOS Bundle makes it easy to mix PCs and Macs on your network. In fact, with TOPS for Sun Workstations, you can even share files with powerful Suns.

Time to get the mail.

If that isn't enough, TOPS DOS Bundle comes with Sitka's all-new InBox electronic mail for sending and receiving files and messages. It's the one E-mail *PC Computing* calls "a piece of cake to install and a pleasure to use."

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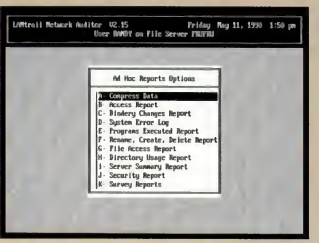
METERING SOFTWARE AT WORK

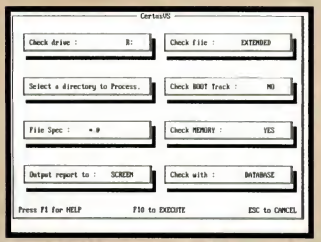
Metering software packages offer a variety of features intended to help the LAN administrator keep close tabs on network usage. Among them are regulating the number of users running specific applications, identifying corrupt executable programs as possible viruses, limiting usage through customized menus, and generating reports on LAN activity.

In addition to its metering features, LANSystems' *LANShell* helps network users find and run applications. A LAN administrator can use the product to produce windowed screens, complete with pop-up explanations, for each major selection.

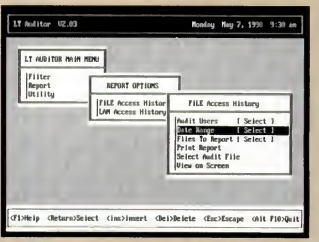
Triticom's *ARGUS/n* uses a simple menu structure to take you through the monitoring, management, and inventory tasks of networks with as many as 250 users.



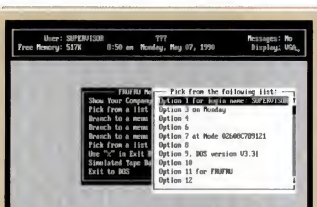
If you want statistical reports of network operation, Network Management Inc.'s *LANtrail* provides them. This ad hoc report menu lets you generate and display a variety of statistics, including who uses what application and when.



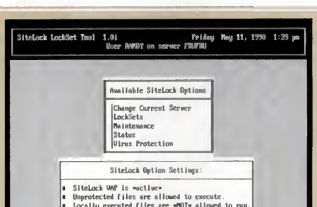
With Certus International's *Certus LAN* 2.0, each file, directory, and even the boot track of each workstation can be checked against a stored image to ensure integrity. The program's includes counting the number of active application copies.



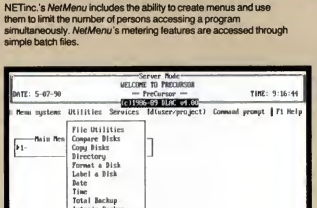
The LAN Access Report provided by Blue Lance's *LT Auditor* 2.03 covers workstation information, user name, as well as log-on and log-off times by date and time. Total areas monitored include file operations, subdirectories, and even specific file extensions.



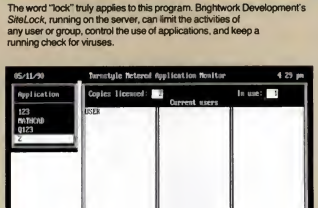
NETinc.'s *NetMenu* includes the ability to create menus and use them to limit the number of persons accessing a program simultaneously. *NetMenu*'s metering features are accessed through simple batch files.



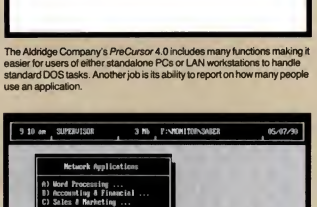
The word "lock" truly applies to this program. Brightwork Development's *SiteLock*, running on the server, can limit the activities of any user or group, control the use of applications, and keep a running check for viruses.



The Aldridge Company's *PreCursor* 4.0 includes many functions making it easier for users of either standalone PCs or LAN workstations to handle standard DOS tasks. Another job is its ability to report on how many people use an application.



Turnstyle, from Connect Computer Co., controls the number of software copies active at all times. As this screen shows, the number of application copies in use and who is using them is reported clearly and is constantly updated.



The menu system of Saber Software's *Saber Meter* provides end users with access to applications and DOS tasks. Network supervisors can also use the product to limit and report on applications run.

McCarty Associates *WorkStation Manager* uses IBM SAA/CUA-type menus to help you build menus following the same standard. Using an internal application language, you can even build menus leading to mainframe applications through gateways.

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CIRCLE 389 ON READER SERVICE CARD

system for any LAN administrator looking for the capability of metering the number of users for network applications. The menu systems are complex to build, but the wide range of tools included help you create a well-designed menu system specifically for your needs.

NETWORK MANAGEMENT INC.

LANtrail

by Kimberly Maxwell

Caught in a LAN paper chase with no apparent end? Network Management's *LANtrail* helps you with the paper trail of reports and the information you receive about your *NetWare* network. *LANtrail* does not prohibit people from using a program if the number of users allowed under a site license is exceeded, but the reports it generates can assist a network manager in controlling the number of program users.

***LANtrail* monitors your LAN's activity without intruding on normal workstation procedure.**

The $595-per-server metering and auditing program runs on the server as an NLM (*NetWare* Loadable Module) under *NetWare 386*. The advantage to this design is that you'll have better security and control of metering abilities. The disadvantage is that the program uses 512K of RAM you might use as a disk cache or program space. All metered workstations require a low 5K RAM for a TSR program.

LANtrail continuously monitors your LAN's activity without intruding on normal workstation routines. *LANtrail* also works across LAN bridges, so you can access data and generate reports from any server you log onto.

LOOKS LIKE NETWARE

LANtrail's user interface is much like *NetWare*'s menu system, which may comfort supervisors accustomed to *NetWare* menus and windows. The printer interface is easy to use or control from any workstation on the network, allowing you to choose any network printer for printing reports.

The program looks at workstation and network activity, tracking the workstation's physical address, along with time of day and user identification. *LANtrail* can give you any assortment of reports generated on a particular user or group of users, or information on a directory name or a combination of several elements. It will also help you trace an entire network's activity.

Along with tracing the programs executed, *LANtrail* keeps tabs on the files that users open, read, write, close, create, delete, and rename. Each report identifies directories with the complete path name. If you want to view a report, you can either review it on-screen or print out the detailed reports.

LANtrail's tight security features keep users who do not possess supervisor rights from altering, processing, or viewing the information it generates. The program's security system tells you when it locks out an intruder or if a system time change occurs.

The product's TSR applications and data compression for archive storage are compatible with *Windows 386* files. Data compression lets you reduce the disk storage requirements for your reports by up to 60 percent.

LANtrail is a *NetWare* supervisor's solution to metering a network. It gives you an abundance of information about your network activity. We found the reports useful and can safely say that network administrators who have to justify budgets, plan for the future, and control modern networks will appreciate the resources *LANtrail* provides.

FACT FILE

LANtrail
Network Management Inc., 19 Rector St., New York, NY 10006; (800) LAN-USER.
List Price: $595 per file server, unlimited node coverage.
Requires: DOS 3.0 or later; Novell *Advanced NetWare 286* or *NetWare 386*; 512K RAM in server, 5K RAM in each workstation.
In Short: *LANtrail* is one of the better metering utilities for reporting network and individual usage. Installation and operation are not difficult if you are familiar with Novell *NetWare*'s menu system.

CIRCLE **607** ON READER SERVICE CARD

SUITABILITY TO TASK

LAN METERING SOFTWARE: SUMMARY OF FEATURES

Products listed in alphabetical order

GENERAL INFORMATION

Program resides:
- In workstation (as TSR)
- In server

RAM required:
- Workstation
- Server

Supports Novell NetWare
- Installs as Value Added Process (VAP)
- Installs as NetWare Loadable Module (NLM)

Supports DOS-based file servers
Alerts of application user limit
Can meter only selected applications/files
Can restrict time on application use
User interface:
- Menu driven
- Command-line driven

Generates reports on usage:
- By file
- By user
- By application

Provides off-line modem support
Controls/reconciles duplicate application files
Application password protection
Call-back feature when application is free
Provides archive storage
Maximum number of applications metered

SUPPORT

Toll-free number
Free support
Contract support available

☐—Editor's Choice ■—Yes ☐—No
N/A—Not applicable: the product does not support this feature.

BLUE LANCE INC.

LT Auditor

by R. Dennis Boatner

Novell LAN administrators can finally breathe a sigh of relief. Blue Lance has found a way to monitor your network, and also give you an audit trail. *LT Auditor* 2.03 offers both flexibility and security for your LAN system. The price is also attractive at only $495 per server.

LT Auditor consists of a RAM-resident program called RAM203.COM that occupies 20K per workstation. This file monitors all the input and output areas of the profile set up by the network supervisor—in other words, the areas of the LAN that the supervisor allows your workstation to access. The areas monitored include file operations, subdirectories, and even specific file extensions.

TRICKY INSTALLATION

The first part of installation is a breeze. After logon as the supervisor, insert the *LT Auditor* disk in your floppy drive and type INSTALL. It automatically configures the *NetWare* environment for proper operation. Step two is not quite as easy. This is the most important step in the installation, since both workstation and user information maintenance require the activation of RAM203.COM. *LT Auditor* forces the execution of the RAM-resident module from within Novell's SYSTEM log in, and USER'S log in.

Entering data into the New Users and Reports section of the program is awkward under the version we reviewed. Both these tasks require four keystrokes for a single entry. The addition of an index section to

	ARGUS/n Triticom	Certus LAN 2.0 Certus International Corp.	LANShell LANSystems Inc.	LANtrail Network Management Inc.	LT Auditor 2.03 Blue Lance Inc.	NetMenu NETinc.	PreCursor 4.0 The Aldridge Company	Saber Meter Saber Software Corp.	SiteLock Brightwork Development Inc.	Turnstyle Connect Computer Co.	WorkStation Manager McCarty Associates Inc.
	$245 per server	$795 per server and first 10 workstations	$495 per server	$595 per server	$495 per server	$295 per server	$95 per workstation	$195 per server	$495 per server	$395 per server	$795 per server
	■	■	■	■	■	■	■	□	■	■	■
	□	□	□	■	□	■	□	■	■	□	□
	4K	12K	9K	5K	20K	1K	1K	N/A	2K	3K	6K
	N/A	N/A	N/A	512K	N/A	256K	N/A	512K	120K; 500K if run as NLM	N/A	N/A
	■	□	□	■	■	■	□	□	■	□	□
	□	N/A	N/A	■	□	□	N/A	N/A	■	N/A	N/A
	□	N/A	N/A	■	□	□	N/A	N/A	■	N/A	N/A
	■	■	■	■	□	■	■	■	■	■	■
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	■	■	■	■	30 days	■	■	■	■	90 days	■
	□	■	□	□	■	□	■	□	□	■	■

MONO

Traditional PC LAN

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VS. MULTI

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Data General's NetWare for AViiON is the first RISC-based NetWare platform. It's fully scalable and can share the server with major standards like TCP/IP. It also uses the standard NetWare client software and Novell's IPX/SPX Networking Protocol, so it interoperates with existing Novell LANs. It lets users access scores of applications. And, Data General offers a Software Developer's Kit to facilitate the development of client-server applications.

Data General's line of Novell NetWare solutions brings transparent networking and distributed applications to all your PC clients.

To learn more about how an AViiON server with Novell's Portable NetWare can bring more power and more applications to your LAN, call the distributors listed below or 1-800-DATAGEN. Also, ask about Data General's full line of PCs.

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3400 Computer Drive, Westboro, MA 01580

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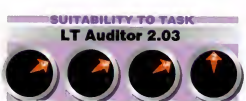


the User Manual would enhance installation, too.

Things get easier once you've completed installation. You'll find that *LT Auditor* is so compatible with Novell, it even writes error messages to Novell's NET$LOG.MSG file. This file contains report errors, warnings, and messages that occurred during *LT Auditor*'s operation. The Errors section contains problems caused by *LT Auditor*. Faults detected by *LT Auditor* go in the Warnings section of the file, and information about file functions goes in the Messages section.

AUTOMATIC DIAGNOSTICS

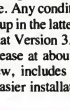
You can automatically run environment diagnostics, purge system data files, and reset your system parameters. *LT Auditor* also detects improper settings and attempts to correct them.

When you want reports, *LT Auditor* provides two different types. The File Access Report gives user name, workstation address, date, time, filename, and path for all files that meet the profile filter. The LAN Access Report covers workstation information, user name, log-on and log-off times by date and time. Any conditions out of the ordinary show up in the latter.

Blue Lance reports that Version 3.0 of the package, due for release at about the time you read this review, includes new multiserver capability, easier installation, and entry tagging for group updates to the User and Report sections.

LT Auditor solves your network problems by detecting and reporting problems to the supervisor. It also provides security by monitoring sensitive files and subdirectories.

FACT FILE



LT Auditor 2.03
Blue Lance Inc., P.O. Box 430546, Houston, TX 77243; (713) 680-1187
List Price: $495 per server.
Requires: DOS 2.0 or later, any version of Novell *NetWare*, 20K per workstation.
In Short: Specifically designed for Novell *NetWare* networks, this program monitors file access on both network and local drives. *LT Auditor*'s ease of installation and operation make managing your network less of a nightmare.

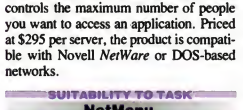
CIRCLE 608 ON READER SERVICE CARD

NETINC.

NetMenu

by Kimberly Maxwell

With ongoing changes in equipment and users on your network, you may find it hard to track people and resources. *NetMenu* is a network menuing program that controls the maximum number of people you want to access an application. Priced at $295 per server, the product is compatible with Novell *NetWare* or DOS-based networks.



This menuing utility is similar to other menu products on the market—it's a utility that lets LAN administrators create menus that people use to start applications and do other tasks. You use these menus in lieu of the DOS command-line entries.

The menus you design using *NetMenu* direct network users to do everything from simple printing chores to program access. You can define each window's color from a six-color palette, define the window's title, and position the title on the screen.

The metering utility is an extra feature in *NetMenu*; it controls the maximum number of users for each application. You include a code word in the text file, similar to a batch file, followed by the number of users you want to designate for a particular application. This defines the number of users who can simultaneously access the application.

SIMPLE TO INSTALL AND OPERATE

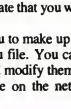
NetMenu's installation and operation are simple: you load a tiny TSR program into every networked PC. This program, requiring less than one kilobyte, is a security module for each workstation. The actual menus run from a standard foreground program on each station. There are individual NETMENU.COM files for all the *NetWare* or DOS-based networks. The TSR provides communications between the network operating system and *NetMenu*. The file acts as a traffic cop; *NetMenu* passes out files or applications based on variables you set in an ASCII file. The menu program sets semaphores or flags in the security program that represent the number of eligible people who can use the application. The limit for each semaphore is 127.

The program denies further access when you reach the maximum allowable number of users, and a message on your screen will state the problem. If you are at the supervisor station or have security clearance equivalent to that of the supervisor, a user list with the location and the log-in time will appear.

To describe the resources on your network and how you would like these resources accessed, you create simple batch files. As with any batch file, you can edit these files with any text editor such as EDLIN. You can also convert *NetWare* menu files into specially defined template files for use with *NetMenu*. A special file called MNUTOMDF performs all conversion work. To execute this file, you must specify the original menu file, the name of the new file, and the template that you want to build.

NetMenu allows you to make up to ten windows in each menu file. You can update the menu files and modify them even though they are in use on the network.

FACT FILE



NetMenu
NETinc., P.O. Box 271105, Houston, TX 77277-1105; (713) 974-1810.
List Price: $295 per server.
Requires: DOS 3.0 or later; Novell *Advanced NetWare 286*, Novell *NetWare 386* or other LAN operating systems; 256K RAM on server, 1K per workstation.
In Short: *NetMenu* is a menuing tool with network metering capabilities. You must be familiar with menu programs to work through this product quickly.

CIRCLE 609 ON READER SERVICE CARD

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CIRCLE 183 ON READER SERVICE CARD

With special lines in your batch files, you control who can see or execute individual menu selections with DOS and *NetWare* function calls. Because *NetMenu* receives the information directly from DOS and the Novell *NetWare* operating system instead of a proprietary set of files, you won't have to perform file maintenance.

This menuing product gives adequate metering control of your network's applications, and it can make your LAN a simpler environment. Nevertheless, you should have some knowledge of the ways a menuing tool works for your network.

THE ALDRIDGE COMPANY

PreCursor

by Gaylan W. King

The Aldridge Company's *PreCursor* 4.0 is a sophisticated menu system designed to be a complete user interface for personal computers or workstations on a LAN. It's priced right at $96 per PC, with special pricing for PCs acting as network nodes. The program has the ability to meter and track computer and applications usage and create complete reports on each subject. It also includes a standard selection of utilities and triple-level password protection.

Installation is simple. Create a subdirectory, PRECURSR, and type A:INSTALL. *PreCursor* will find your AUTOEXEC.BAT file, copy it to AUTOEXEC.BAK, and create a new AUTOEXEC.BAT that will take you into the menu at bootup. If you don't want automatic execution, delete the AUTOEXEC.BAT entries and execute the program like any other. The system CONFIG.SYS file must include the statement DEVICE=ANSI.SYS.

As you might guess, the next logical step for the user is to create a menu. The documentation could be much more explicit at this point. A macro-view of what the program is intended to do would be welcome. We would also like to see descriptions of how the menus should look on the screen and what must be done to plan system use. This is not a program that you can just throw on your hard disk and immediately start to use. But if you take the time to wade through the documentation and do some serious thinking about what *PreCursor* will do for you, the program can reward you.

If you take the time to wade through its documentation and do some serious thinking, *PreCursor* can reward you.

TWO WINDOWS

PreCursor's menu consists of two windows, the Main Menu and the Menu Page. The Main Menu lists up to 11 applications by groupings, such as Utilities, Spreadsheets, Word Processors, MIS Dept., and so on. When you select one of these groups, the other window, the Menu Page, lists as many as 11 programs in that grouping for selection. Obviously, must include all programs you intend to meter and record. You can use a System Maintenance screen to create and alter your menu. It allows you to list the chosen programs for selection by Menu Page, and automatically determines the program path.

The Utilities Menu offers a standard array of DOS and related file management operations. You can prohibit people from using this menu if you don't want them to have DOS capabilities. An interesting User/Project ID field accepts user and project IDs if the computer usage option has been turned on in the Maintenance section.

If you wish, *PreCursor* can write a file to disk that lists all computer activity. This file compiles information about which menu items have been executed, including the amount of time used, user name, and project IDs.

PreCursor creates reports in a variety of formats. These include a Computer Activity Log, an Application Summary, and a User and Project ID Summary. These formats are sensible and informative, and they can be transferred to a spreadsheet or even a mainframe. When you consider that *PreCursor* also offers mouse support, hotkey access, pull-down windows, and point-and-shoot file lists, the program is a reasonable value.

Unfortunately, the documentation is murky. Unless you either have a sound understanding of menu programs or like puzzles, another metering and menu option may be a better choice.

FACT FILE

PreCursor 4.0
The Aldridge Company, 2500 CityWest Blvd., #575, Houston, TX 77042; (800) 548-5019, (713) 953-1940.
List Price: $96 per computer for Version 4.0; upgrades to registered owners for $29.95; networks require one copy per workstation, with special pricing available based upon network size.
Requires: DOS 3.0 or later for network use; any network operating system; 1K per workstation.
In Short: *PreCursor* 4.0 lets managers measure and track computer usage by total activity, applications summary, and user and project I.D. statement and summary. Comprehensive reports are created for each category. Because of lackluster documentation, it is probably better suited to the experienced user.

CIRCLE 610 ON READER SERVICE CARD

SABER SOFTWARE CORP.

Saber Meter

by Kimberly Maxwell

Saber Software's LAN metering tool, *Saber Meter*, gives you a clear-cut view of your network by user and application. The economical program also ensures compliance with application license agreements, once the supervisor has set the parameters during the initial application report process.

This $195-per-server product provides details on network use by individual in

FACT FILE

Saber Meter
Saber Software Corp., 5944 Luther Lane, #1007, Dallas, TX 75225; (800) 338-8754, (214) 361-8086.
List Price: $195 per server.
Requires: DOS 3.1 or later; Novell *NetWare*, Banyan *VINES*, or any DOS-based LAN operating system; 512K RAM in server.
In Short: *Saber Meter*, an attractive program for *dBASE* users, is a good metering program compatible with most larger networks. It creates clear and concise reports and meters your applications' use so you don't exceed their licensing limits.

CIRCLE 611 ON READER SERVICE CARD

easy-to-understand reports. The installation is straightforward, and *Saber Meter* works with Novell *NetWare*, 3Com *3+Open*, Banyan *VINES*, IBM *PC LAN*, CBIS *Network OS*, and other PC-compatible networks.

If you install *Saber Meter* in a Novell *NetWare* or Banyan *VINES* network, the installation process varies slightly from the norm. The manual contains all the necessary information for installation, and it assists you with your technical questions.

Saber Meter's METER.EXE program records audit data in a *dBASE* file.

During setup, you can select or keep default screen colors within the color utility. You must ensure each workstation has a certain number of file and buffer entries in the CONFIG.SYS file. You must also identify the network server, provide a user name to identify each user, and give the station number to identify the workstation. You can set these by using the DOS command line and use S_SERVER, S_USER, and S_STATION as front-end variables.

INCLUDED PROGRAMS

With METER.EXE, one program included with *Saber Meter*, you can gather data and audit application packages on your network. This program records the audit information in a standard parameters *dBASE* file. The meter program logs the information, such as the length of time a user was in an application and how many users the system rejected because of an error. METER.EXE also limits the number of people using an application by using previously entered maximum user numbers for an application. METER.EXE isn't memory resident; it's integrated into DOS batch files or menu system scripts.

The package also includes *Saber Browse*, a *dBASE* database browser and meter-file report generator. The "Z" record feature records when users do not exit applications before logging out of their workstation. The METER program timestamps the database file, and the *Browse* program indicates users who may have open files in an application.

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CIRCLE 290 ON READER SERVICE CARD

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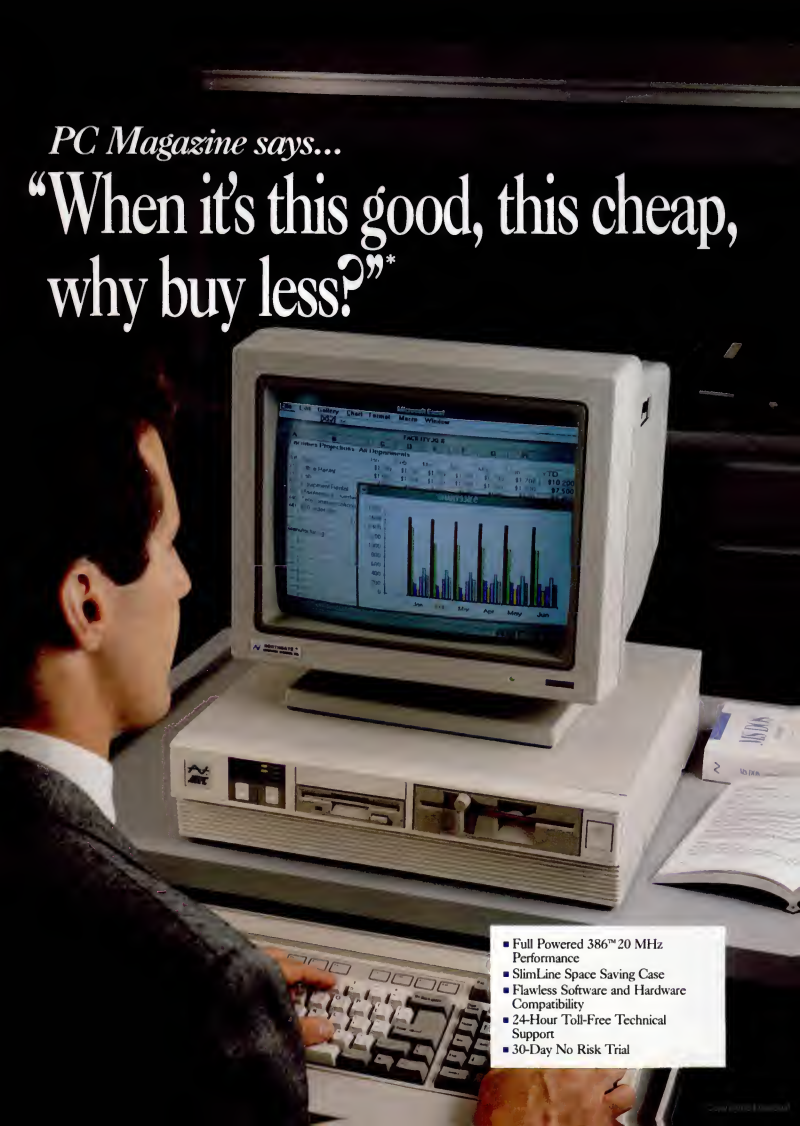

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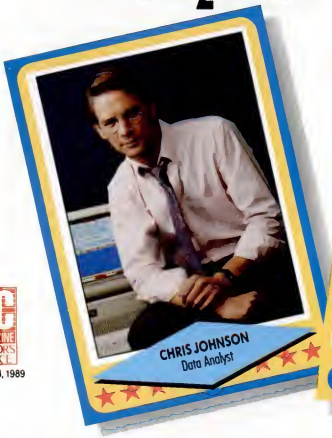

CHRIS JOHNSON Data Analyst

CAREER HIGHLIGHTS:

1983
Proposed remap of sales territories based on SPSS analysis of economic and consumer trends. Increased new-customer revenues 38% in 2 years.

1985
Used SPSS data entry/tabulation system to administer employee benefits more efficiently. Eliminated outside costs of more than $75,000.

1986
Identified current customers likely to need added services, increasing average billings by more than 20%.

1988
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PC MAGAZINE EDITORS' CHOICE
March 14, 1989

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CIRCLE 103 ON READER SERVICE CARD

The *Browse* program is the "presenter" of information as well as an ad hoc report generator. It provides a *dBASE* file display, editing and printing raw *dBASE* data and turning it into useful printed reports.

Also available from the *Browse* program is an on-line menu system and a Help facility. You can use hotkeys to locate a report, open a database and even set a filter. You can scroll through collected data to check usage times, file sizes, and user names, arranging the information in priority form according to your needs. You can modify the reports or change the structure of a database file. It isn't difficult to merge one database file with another. Another included program, MREPORT, runs batch reports against the *Meter* databases for repetitive reporting needs.

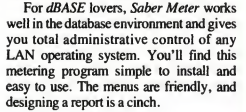
For *dBASE* lovers, *Saber Meter* works well in the database environment and gives you total administrative control of any LAN operating system. You'll find this metering program simple to install and easy to use. The menus are friendly, and designing a report is a cinch.

BRIGHTWORK DEVELOPMENT INC.

SiteLock

by Kimberly Maxwell

Need help protecting your *NetWare* LAN from viruses and unwarranted intrusion? Brightwork Development's *SiteLock* may



be for you. *SiteLock* checks application site licenses and locks out anyone trying to access the application when the specified number of users are already running the program. *SiteLock* also checks applications' files to see if the executable programs are corrupt—helping to protect your network from viruses.

The $495 product runs on the Novell server as a VAP (value-added process) in *Advanced NetWare 286* servers and as a NLM (*NetWare* loadable module) in servers running *NetWare 386*.

The software consists of two modules: the network module (VAP/NLM) and the WATCHER program. The main network program performs actual monitoring and control functions from the server. The memory-resident WATCHER program runs in each networked PC and there requires 2K RAM. When you use either the VAP or the NLM, you must allot 150K RAM in your *NetWare* server. The NLM, however, requires an additional 500K RAM for Novell's CLIB/STREAMS library.

The WATCHER program located in

> ***SiteLock*'s automatic call-back feature informs a user who previously tried to use an application that a copy of the software is free.**

each workstation issues requests to the server master programs. The network module processes the requests, checks the software metering status, checks the purity of the programs' code, and issues permission or denial to the workstation. WATCHER allows the program to execute or terminates its execution while issuing a message from the network NLM or VAP on the screen.

SiteLock maintains a queue of the users locked out. An automatic call-back feature informs a user who previously tried to use an application that a freed copy of the software is available. An adjustable time feature regulates how long a person can keep a program active. You can also find out who is using applications in real-time on the network. A nifty SLOOK program lets any network user see who is using what software on the LAN.

STRAIGHTFORWARD INSTALLATION

SiteLock's straightforward installation doesn't take much time. The manual aptly describes the smooth installation, and on-line help is available.

PC MAGAZINE FACT FILE
EDITOR'S CHOICE

SiteLock
Brightwork Development Inc., 766 Shrewsbury Ave., Jerral Center West, Tinton Falls, NJ 07724; (800) 552-9876, (201) 530-0440.
List Price: $495 per file server.
Requires: DOS 3.1 or later; Novell *Advanced NetWare 286*; Novell *NetWare 386*; 120K RAM in *NetWare 286* or *NetWare 386* server; 160K RAM in *NetWare 386* server; 00K if run as *NetWare* Loadable Module); 2K RAM in each workstation.
In Short: *SiteLock* is a good metering tool that gives you adequate reports and limits the number of users for each application to ensure compliance with site license agreements.

CIRCLE 612 ON READER SERVICE CARD

The program uses three databases that perform a variety of tasks. They report each application's metering parameters, showing you a list of virus-protected programs and the status of the *SiteLock* system. One database contains records of software use, detecting any corrupt program files.

The reports *SiteLock* generates are easy to follow. The menu-driven interface helps you move within the windows, entering and exiting each window with one keystroke. If you have any questions about the product or if you experience trouble while installing or setting up the product, there is a toll-free customer support line at no extra cost to *SiteLock* owners.

SiteLock supplies you with valuable information to save you money. It shows how people use applications, so you can avoid purchasing unnecessary copies of software. If you do need additional copies, *SiteLock* alerts managers with a screen message. You can also designate the maximum number of users per application to help maintain site license agreements.

In addition, there are *SiteLock Developer Kits* available that allow software developers to integrate *SiteLock*'s features to limit the number of simultaneous users. The *Developer Kit* price starts at $2,495 and includes all the *SiteLock* software plus a license for use with 100 products.

SiteLock is a well-balanced metering tool with a wide range of functions and internal options. The program isn't complicated and it has the reports and data necessary to give a LAN manager clear insight into application use on a Novell network.

CONNECT COMPUTER CO.

Turnstyle

by Kimberly Maxwell

"Simple to operate" and "easy to love" describe Connect Computer's *Turnstyle*. This $395 LAN metering product was formerly a segment of *Lanscope*, a multifeatured network management system. Connect Computer broke out *Turnstyle* and made it into a standalone metering product, although the $695 *Lanscope* still offers the capabilities of both products.

Turnstyle provides a way to control and meter copies of applications on the network. Along the way, there are several requirements and setup tasks that need special attention. *Turnstyle* is not a server-based application; it runs as a TSR using 3K RAM or as a foreground utility on each workstation.

Turnstyle runs on a variety of network operating systems including Novell *NetWare*, IBM *PC LAN*, Banyan *VINES*, and 3Com *3+Open*. You place the program files on the network server and include a command in the log-in script. In some cases, you must exit to a batch file and make adjustments. In *VINES*, the profile command is called POSTLOGIN; in *NetWare*, the log-in script command is EXIT with a filename parameter. In other networks, you modify a batch file used to log into the network, in order to load the TSR option.

After installing the software on your network, you enter information about each software application into a database. You can edit or delete this information in the database at any time and enter the serial number of the application for future reference. Based on the database information and the number of copies to which you limit each application, *Turnstyle* controls the number of software copies active at all times. For example, if you enter a five-user maximum for *Lotus 1-2-3*, only five users can access *Lotus* at one time. The sixth user attempting to use the application will see a message saying all copies of the software are in use.

> *Turnstyle* can let you make some files accessible to the administrator only, for tighter security.

If you receive a message telling you that the maximum number of copies are in use, a feature tells you when the application will be available. You must remain in a waiting state for the application to receive this message and respond to it within 10 seconds, or it will proceed to the next user request.

EXECUTE-ONLY FILES

For additional security, you can make all metered applications on Banyan *VINES* and *NetWare* execute only. This prevents network users from making copies of the applications on their hard disks or onto floppies. You can also makes files accessible to the administrator only; this provides tighter security and restricts users from accessing files. For example, you can allow a user to only read a file and take away his write and create abilities.

The menu system doesn't take much effort to use. Many of the functions and commands are self-explanatory, but if you come across any difficulty, there's an online help utility. Any data entry into the database is simple, and with the manual's assistance you can finish setting up your LAN's application list within minutes.

The reports are clean and easy to follow, giving you information about your network's applications in database form. You can receive the reports with or without application serial numbers in a screen display or in printed form. There is a detailed license conflict report showing time/date, application, and user; also noted is when requests to run applications were canceled for some reason.

If you want more than just metering, *Lanscope* (which includes *Turnstyle*) manages hardware and software resources for the network server and each workstation. It also provides a complete menuing system. Note, however, that *Lanscope* is a RAM-hungry application and is more complicated to install and set up than the *Turnstyle* databases.

Turnstyle gives you many metering capabilities at a low price, with simple installation, setup, and operation. The range of compatible networks and easy-to-read reports on application usage make this program a healthy competitor.

PC MAGAZINE FACT FILE
EDITOR'S CHOICE

Turnstyle
Connect Computer Co., 9855 West 78th St., #270, Eden Prairie, MN 55344; (612) 944-0181.
List Price: $395 per file server; site licenses available.
Requires: DOS 3.0 or later, any network operating system, 3K RAM in each workstation.
In Short: *Turnstyle* is an easy-to-use, clean reporting program showing network and application use. It also limits the number of users on an application so you can stay within site license agreements.

CIRCLE 613 ON READER SERVICE CARD

McCARTY ASSOCIATES INC.

WorkStation Manager

by Sara Parker

McCarty Associates' *WorkStation Manager* is a powerful and ponderous package. A savvy network manager can use it to create spectacular menus conforming to IBM's Common User Access (CUA) specifications, a part of IBM's Systems Application Architecture (SAA). With an investment of some "sweat equity," you can create menus that do everything—including leading users through mainframe file interaction activities.

FACT FILE

WorkStation Manager
McCarty Associates Inc., 929 Boston Post Rd., Old Saybrook, CT 06475; (203) 388-6994.
List Price: $795 per server, $395 for five-user LAN version; Novell add-in library available at no additional cost.
Requires: DOS 3.1 or later, any LAN operating system, 6K in server.
In Short: An excellent menuing program for people who aren't afraid to use an application language. A special add-in library for *NetWare* adds application metering.

CIRCLE 614 ON READER SERVICE CARD

While the $795-per-server package works on any network as a menu and DOS shell package, a special add-in library gives it the ability to meter applications on servers running all versions of Novell's *NetWare*.

Installation takes place through a series of batch files. The program comes on three 5¼ inch disks, and the Novell library is on a fourth. Additional libraries, like an interface to Action Technology's MHS, are under development. The program uses only 6K of RAM to execute, so it will run even in PCs with a small memory.

POWER AND FLEXIBILITY

WorkStation Manager stands head and shoulders above the competition in terms of power and flexibility. The menus it creates can overlay each other on the screen, provide shadow bars for topic selection, and give extended help. The keystrokes, screens, and general "look and feel" conform to IBM's CUA standards, including an interface for a mouse and other pointing devices. You can use this menu format to integrate seamlessly, behind a CUA user interface, both locally developed applications and others with less than intuitive interfaces.

When the program is run under Novell *NetWare*, you can meter literally anything you can run, including batch files. The metering functions let you set up a wide variety of limits and options, which exist in a separate library of information. When someone tries to execute a metered program at its limits of use, the product pops up a message you've created that describes the limitation and suggests a course of action. Unfortunately, the program doesn't go back and inform a disappointed user when the application is available. Also, the package doesn't include the capability to limit the time a person can use an application.

If users in your organization need to get information from a mainframe, you can use *WorkStation Manager* to create menus that initiate intricate data request functions through standard LAN gateways like IBM's *SNA 3270* and many others.

WorkStation Manager provides you with the framework to build mainframe inquiry applications. You have to know how to write the code to make things happen—experience with BASIC, C, or COBOL would help—but if you provide the code, network users need little or no knowledge to interact with mainframe systems.

> *WorkStation Manager*'s metering functions let you set up a wide variety of limits and options, which exist in a separate library of information.

Once set up, *WorkStation Manager* is a simple but solid LAN metering tool. It's also a much fancier menu system than most, containing the tools to make life easier for everyone on the network. But like all tool kits, you must provide the skill to generate the final work. ■

R. Dennis Boatner *is a computer consultant working in northwest Florida.* **Gayland W. King** *is the manager of a large federal government network. He is also a computer consultant.* **Kimberly Maxwell,** *a newspaper journalist, is a frequent contributor to* PC Magazine. **Sara Parker** *has years of experience as a telephone software support representative and as a computer consultant.*

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VGA-Color	$860	$960	$1140	$1280	$1730
SVGA-Color*	$970	$1070	$1250	$1390	$1840
Portable VGA	NA	$2470	NA	$2790	$3240

For benchmark scores on hard drives, see "Pure Power" pages
* SVGA 1024 x 768 interlaced
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- High Capacity System Power supply
- Real Time Clock/Calendar with 5 Year Battery
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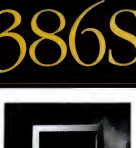

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VGA-Color	$860	$960	$1140	$1280	$1730
SVGA-Color*	$970	$1070	$1250	$1390	$1840
Portable VGA	NA	$2470	NA	$2790	$3240

For benchmark scores on hard drives, see "Pure Power" page

* SVGA 1024 x 768 interlaced

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VGA-Mono	$730	$910	$1050	$1500	$2050	$2840
VGA-Color	$960	$1140	$1280	$1730	$2280	$3070
SVGA-Color*	$1070	$1250	$1390	$1840	$2390	$3180
Portable VGA	$2670	NA	$2990	$3440	NA	NA

For benchmark scores on hard drives, see "Pure Power" page
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PC BRAND 486's

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VGA-Mono	$910	$1050	$1500	$2050	$2840
VGA-Color	$1140	$1280	$1730	$2280	$3070
SVGA-Color*	$1250	$1390	$1840	$2390	$3180

For benchmark scores on hard drives, see opposite page.
* SVGA 1024 x 768 interlaced
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- 80387 or Weitek CoProcessor support
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Options:

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- Low Profile Slim Line Case w/3 Disk bays
- Mini Sized Tower* Case w/4 Disk Drive bays
- Custom configurations with Name Brand peripherals of your choice
- Factory Installed Ram Upgrades

PC BRAND 386 Cache

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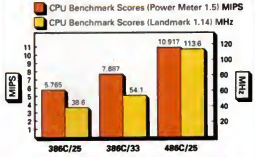
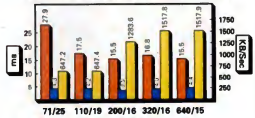
Hard Drives: MB/MS	40/19	71/25	110/17	200/19	320/16	640/15
Mono	$550	$730	$870	$1320	$1870	$2660
VGA-Mono	$730	$910	$1050	$1500	$2050	$2840
VGA-Color	$960	$1140	$1280	$1730	$2280	$3070
SVGA-Color*	$1070	$1250	$1390	$1840	$2390	$3180
Portable VGA	$2670	NA	$2990	$3440	NA	NA

* SVGA 1024 x 768 interlaced





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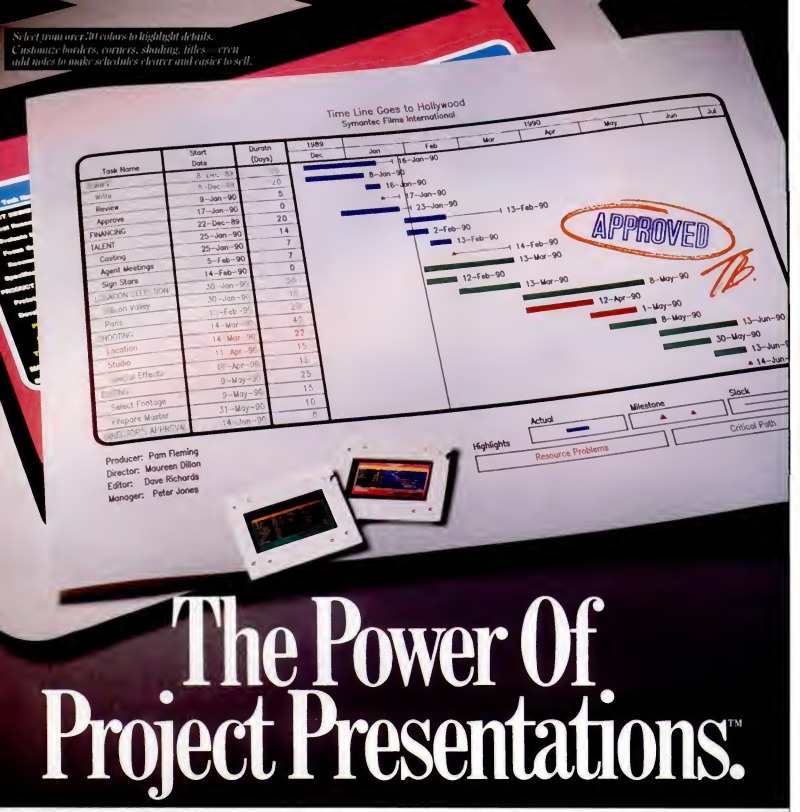
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Projects spring to life with immediate meaning.

Time Line has added a unique type of graphical excitement to its output. The graphs and charts you can produce are stunning. You can use rounded corners, colored backgrounds, different line treatments, and customized legends. *Time Line* also lets you print these graphs to a wide range of devices including film recorders.

An especially nice feature of *Time Line*'s graphics is the ability to preview the output in full WYSIWYG splendor. You can skip around the output pages and even enlarge or reduce your view, letting you squeeze your graph onto one page before you send it to the printer or plotter.

ON THE BANDWAGON

Still to come this fall from Computer Associates, the makers of *Super Project Expert*, is an OS/2 Presentation Manager version. At the same time, a new DOS version with an OS/2 PM look should arrive.

The people at Symantec, the makers of *Time Line*, talk about "being committed to keeping up with the market," which could mean that they'll produce a graphical version when the installed base for *Windows* or Presentation Manager is deemed large enough. There is similar talk about standard graphics environments from Scitor, which already has a Macintosh version and is looking hard at Unix as well.

When everyone is graphical, the focus will shift to workgroup facilities. Project management is a natural for workgroup computing and the client/server environment because projects almost always involve teams, have a specific time-bound goal, and cross a number of departmental boundaries—all the essential elements of groupware.

There is some slight movement in this direction already. *Time Line*'s WBS manager accomplishes one necessary, albeit minor, step in this direction: coordinating data in a way that it can be consistently maintained across applications. But the biggest step in that direction has been taken by a software package outside the field—*Syzygy* (see the sidebar "Syzygy: Project Management as Metaphor").

There is room for improvement in the precision of resource and cost management in low-end project management packages, and report writing could become more flexible. We may also see the introduction of some totally new features, such as risk analysis and artificial intelligence. Those new developments may not turn this big but somewhat arcane category into one as popular as word processing, but it certainly promises plenty of excitement.

Harvard Project Manager

Harvard Project Manager includes more ways to build a project than any other program at the low end. You can use the popular outline approach, a work-breakdown chart, Gantt chart, PERT chart, or task list. You can also use a graphic approach unique to this package called Fast Track, which combines chart elements for quick and easy project planning. The $695 Version 3.01 from Software Publishing Corp. uses a glitzy design with colorful, pull-down menus and split-screen views.

However, working with this plenitude of graphs, tables, and forms is a bit cumbersome because of some quirks, which can seriously affect your schedules. The package does not support true multiple projects and has a fairly low task capacity per project. It's also slow at switching screens and calculating.

Harvard Project Manager's first screen is an attractive main menu with choices including Create a Project, Edit a Project, Resources, and Reports. The latter two choices let you work without opening a specific project, thus saving time if you want to quickly generate a report for upper management.

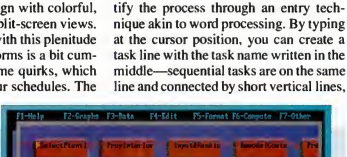
FACT FILE

***Harvard Project Manager*, Version 3.01**
Software Publishing Corp., P.O. Box 7210, 1901 Landings Dr., Mountain View, CA 94039-7210; (415) 962-8910.
List Price: $695.
Requires: 512K RAM, hard disk, DOS 2.0 or later.
In Short: *Harvard Project Manager* has nicely designed screens with good use of color. It lets you build a project schedule in quite a few different ways and also lets you split the screen to see combined views of your project. However, the program has only limited multiple-project support, some quirks in its translation between WBS and PERT charts, is limited to 280 tasks in a schedule without using subprojects, and is slow.

CIRCLE **410** ON READER SERVICE CARD

THE FAST TRACK

Create a Project presents you with the blank Fast Track screen, meant to demystify the process through an entry technique akin to word processing. By typing at the cursor position, you can create a task line with the task name written in the middle—sequential tasks are on the same line and connected by short vertical lines, and parallel tasks are on different lines. In the end, you have a compressed network diagram and a bar chart combined.



***Harvard Project Manager* lets you have two active windows, and each one can be split to show two views at once. Here, the PERT chart is displayed above the cost chart. The window below has a split-screen view showing the Gantt and work-breakdown charts.**

Fast Track automatically links tasks for you, but you will probably have to adjust the links to match your schedule. You can do this in Fast Track by using the Define Link form or by going to the PERT chart. One of Fast Track's nice features is the ability to adjust task duration by stretching or shrinking the task bar with the plus and minus keys. This is as close to direct

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The one on the right is theirs. The Toshiba T3100SX.* With the same configuration as our laptop. It didn't win the same award from *InfoWorld*. But it did tie with Dell for *PC Magazine* Editor's Choice Award.

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Low-Cost Project Management:

SEVEN UNDER $700

Programs such as *Microsoft Project for Windows, Project Scheduler 4,* and *Time Line* are leading the way toward more-graphical, more-accessible project management.

by Henry Fersko-Weiss

For years, manufacturers of low-end project management programs have strived to endow their products with scheduling and tracking features found in high-end packages that cost three times as much. This effort has met remarkable success—so much that the functional difference between packages under $700 and those over $2,000 is smaller than ever. The seven programs evaluated here can hardly be called low-end in functionality and performance, and they all have the advantage of being highly interactive and easy enough for non-professional use. Now that this group has achieved a common set of project management features, the competitive battleground is shifting once again. The latest front is graphics—both screen display and output—and two packages, *Microsoft Project for Windows* and *Time Line*, are now leading the way. The first product to take a strong graphical stand was *Project Scheduler 4*. When it first came out two years ago with a graphical user interface of its own, *PS4* showed that project management was an ideal area for a graphical environment. Nearly every existing package that is not graphical will probably be so within the next 18 months.

VARYING CAPACITIES

One of the major differences between low-end and high-end packages has always been the size of the projects they could handle. If your project had more than 1,000 tasks with lots of resources attached, or you needed to manage a large number of projects with a common resource pool, you simply had to buy an expensive high-end package. The average large project has about 1,200 tasks, and the low-end packages couldn't handle more than a few hundred.

The reason is simple. Unlike word processors and spreadsheets, project management packages weren't all born on the PC. Long before 1981, project management

was a minicomputer and mainframe application. High-end PC packages were almost all ported down from big systems. NASA-sized projects were possible, but performance was slow.

Low-end manufacturers started from scratch and thought in PC product terms—interactive and fast. This meant keeping entire projects or project groups in RAM at the same time. The trick here was to put a rich set of critical path rules and real-world modeling into programs under such constraints.

It took powerful machines and expanded memory to make this truly possible. Now every one of the packages we review here, except *Harvard Project Manager*, can handle well over 1,000 tasks, and using subprojects *Harvard* can too. A couple of the packages can handle 2,000 tasks per schedule and, depending on the amount of memory you have, *InstaPlan 5000* can handle up to 16,000 tasks in one project. To do this, most packages will support EMS and/or extended memory up to 8MB.

If you have such a system, the number of tasks you can handle in multiple projects is astonishingly large. Scitor, the makers of *Project Scheduler 4*, estimates that you can get about 6,000 tasks for every megabyte of EMS, so its program is capable of 45,000 to just under 50,000 tasks—depending on resources and notes.

Although *Harvard Project Manager* and *Micro Planner for Windows* have lower-than-average capacities, they fit the rest of our review criteria quite well. All seven support multiple projects, allow for partial resource assignment and automatic resource leveling, offer summarization through an outline and/or work-breakdown structure codes, and do a good job of scheduling and tracking.

High-end PC packages still have an edge, however, with the depth of some of their features. You can do more-thorough coding, cost analysis, and resource allocation in products like *Artemis, Open Plan, PlanTrac, Primavera, Project Planner,* and *ViewPoint*. These products also give you almost unlimited reporting facilities, sometimes incorporating their own scripting language. On the other hand, these packages ranging from $3,000 to $4,000 are much harder to use, and are more likely to be found on the PCs of professional project managers.

LOOKING GOOD

Graphics are starting to play an essential role in most software categories, but they are particularly useful in project management since it's such a graphically oriented process. After all, the two main tools of scheduling, the Gantt chart with a series of task bars stretched out below a time scale, and the PERT chart with boxes representing tasks and connecting lines representing dependencies, are graphical.

Although *Project Scheduler 4* was the second package to use a graphical user interface—following the *Windows*-based *Micro Planner*—it was the first such program to capture the imagination of project planners. Now, the releases of *Microsoft Project for Windows* and *Time Line*, Version 4, have confirmed the trend toward graphics. *Project for Windows* in particular has shown how cleverly a graphical user interface can be incorporated into project management. The program lets you increase or decrease the duration of a task by stretching or shrinking its bar on the Gantt chart. As you do so, a pop-up date box tells you exactly what date you've hit. Tasks in the PERT chart can be dragged around on the screen, and dependencies can be drawn by mouse.

Project for Windows lets you customize project views by combining any two screens in a split-screen view. You can totally control the format, from selecting the font, point size, and color of all the text, to giving Gantt-chart bars different patterns and colors, varying line thickness, showing grids, or shadowing boxes.

EDITOR'S CHOICE

• Microsoft Project for Windows

Microsoft Project for Windows is clearly the best all-around project management program for under $700. Its interface, particularly under *Windows* 3.0, is superb. (The package comes with a runtime version of *Windows* 2.11.) Besides the usual scroll bars and pull-down menus, you can directly manipulate the bars on the Gantt chart and the boxes on the PERT chart. Icons let you quickly call up data entry forms or link tasks for single or multiple operations. Pop-up boxes on the Gantt chart give you date or task coordinates as you work with task bars or scroll through the project.

The scheduling and tracking features are broad and deep. In fact, the only missing pieces are priorities for projects, cost diagrams, a time-scaled network diagram, and the ability to enter inflation costs.

Microsoft Project for Windows would be a worthy contender on the basis of its features and interface alone, but the program offers much more. You can create combination views using any two of the single views. This means you can have a Gantt chart with a PERT chart, or a histogram with the task form and so on. The program also gives you expansive control over formatting. You can change fonts, point size, text colors, Gantt bar and PERT box treatments, and more.

While *Project for Windows* has set a new standard, two other programs are also strong contenders: *Project Scheduler 4* and *Time Line*. Like *Project for Windows, Project Scheduler 4* has a graphical user interface, although it's proprietary. Its advantage is that you don't need more than 512K RAM or to be a *Windows* user. The appealing screen design and the ability to see different types of project data with the Gantt or PERT charts makes the package an excellent choice.

The program is also fast, but you have less formatting control and flexibility in views than you do in *Project for Windows*. If you can't upgrade your system to *Windows* but want to work with a graphical interface, *PS4* is the best choice.

Time Line is a character-based package, and you can't get the same quality of display graphics and flexibility in views as with the other two. However, you can create named layouts showing different columnar information alongside the Gantt chart. *Time Line* also produces superb output, better than that of *Project for Windows*, and it has great macro facilities.

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PROJECT MANAGEMENT: SUMMARY OF FEATURES

Products listed in ascending price order

	InstaPlan 5000	Micro Planner for Windows	Project Scheduler 4	Harvard Project Manager	Microsoft Project for Windows	Super Project Expert	Time Line
	$495	$595	$685	$695	$695	$695	$695
INTERFACE							
Graphical user interface	❑	■ (*Windows* 3.0)	■ (proprietary)	❑	■ (*Windows* 3.0)	❑	❑
Mouse support	❑	■	■	❑	■	❑	■
Split-screen capability	■	❑	■	■	■	❑	■
On-screen Gantt manipulation	■	❑	■	■	■	■	■
On-screen PERT manipulation	■	■	■	■	■	■	■
CHART TYPES							
Gantt	■	■	■	■	■	■	■
PERT	■	■	■	■	■	■	■
Baseline vs. actual Gantt	■	■	■	❑	■	■	■
Work-breakdown structure	❑	❑	❑	■	■	■	■
Time-scaled network	■	❑	❑	■	❑	❑	■
Resource histograms	■	■	■	■	■	■	■
Cost bar chart/curves (BCWS, BCWP)	■	■	■	■	❑	❑	❑
NETWORKING							
Network version or LAN pack available	❑	■	❑	❑	■	■	■
File-locking capabilities	N/A	Read-only	N/A	N/A	■	■	■
Password support	N/A	❑	N/A	N/A	■	■	❑
Query while file is locked	N/A	■	N/A	N/A	■	■	■
MEMORY UTILIZATION							
Extended-memory support	❑	❑	❑	■	■	■	■
Expanded-memory support	■	❑	■	■	■	■	■
Virtual memory via disk swapping	❑	❑	❑	❑	■	❑	■
Amount of hard disk space needed	1.4MB	720K	1.1MB	1.7MB	2.0MB	1MB	5MB
HARDWARE SUPPORT							
Disk space required for all functionality with one printer driver loaded	1.4MB	720K	1.1MB	1.7MB	3.0MB	1.2MB	5MB
PostScript or PCL5 support	❑	■	■	❑	■	❑	■
Number of printers supported	80	140	22	30	190	150	Unlimited
Plotter support	❑	■	■	■	■	■	■
Film-recorder support	❑	❑	❑	❑	❑	❑	■
ORGANIZATIONAL TOOLS							
Outline structure:	■	❑	❑	■	■	■	■
Number of levels	11	N/A	N/A	99	5	9	Unlimited
Zoom on PERT chart:	❑	■	■	■	■	■	■
Number of levels	N/A	1	5	3	5	4	Unlimited
Support for WBS codes:	❑	❑	■	■	■	■	■
Number of characters in field	N/A	N/A	10	12	80	16	30
Support for OBS codes:	❑	❑	■	❑	■	■	■
Number of characters in field	N/A	N/A	10	N/A	80	6	30
Provides filter histogram for each level of resource outline	■	■	■	❑	■	■	❑
Priorities on projects	■	❑	❑	■	❑	■	■
CUSTOMIZATION TOOLS							
Project log	■	❑	❑	❑	■	❑	■
Task and/or resource notes	■	❑	■	■	■	■	■
Scripting language available	❑	❑	❑	❑	❑	❑	■
Macro recording available	❑	❑	❑	❑	■(Windows 3.0)	■	■
TASK MANAGEMENT							
Maximum number of tasks per project	16,000	1,364	2,000	280	2,000	1,200 in DOS, 2,800 in EMS, 27,000 in OS/2	Limited by RA
Maximum number of tasks overall	16,000	1,364	Limited by RAM	Limited by RAM	2,000	32,000	Limited by RA
TASK DURATIONS							
Minutes	❑	❑	■	■	■	❑	■
Hours	■	❑	■	■	■	■	■

☆—Editor's Choice ■—Yes ❑—No
N/A—Not applicable, product does not have this feature

CONTINUES

PROJECT MANAGEMENT: SUMMARY OF FEATURES

	InstaPlan 5000	Micro Planner for Windows	Project Scheduler 4	Harvard Project Manager	Microsoft Project for Windows	Super Project Expert	Time Line
TASK DURATIONS							
Days	■	■	■	■	■	■	■
Weeks	■	■	■	■	■	■	■
Months	■	❑	■	■	❑	❑	■
Years	■	❑	❑	■	❑	❑	❑
Schedule rules:							
As soon as possible	■	■	■	■	■	■	■
As late as possible	■	■	■	■	■	■	■
Fixed date	■	■	■	■	■	■	■
Task priorities	■	❑	❑	❑	■	■	■
MODELING							
Start to finish	❑	■	❑	■	■	❑	■
Finish to start	■	■	■	■	■	■	■
Start to start	■	■	■	■	■	■	■
Finish to finish	❑	■	■	■	■	■	■
Lags between tasks	■	■	■	■	■	■	■
Negative lag (lead time)	❑	■	■	■	■	■	■
Dependencies:							
Set on Gantt chart	■	❑	■	■	■	■	■
Set on PERT chart	■	■	■	■	■	■	■
Show all in current task	■	■	■	■	■	■	■
RESOURCE MANAGEMENT							
Maximum number of resources per project	16,000	26	500	200	2,000	Unlimited	300
Maximum number of resources per task	16,000	20	Unlimited	200	20	Unlimited	24
Resource-driven scheduling	■	■	■	■	■	■	■
Cross-project resource leveling	■	■	■	■	■	■	■
Resource calendar	■	❑	■	■	■	■	❑
Resource smoothing	■	❑	❑	❑	❑	■	■
Cost codes	❑	❑	■	❑	■	■	■
TRACKING FEATURES							
Baseline comparison (time)	■	■	■	■	■	■	■
Baseline comparison (cost)	■	❑	■	■	■	■	■
Percent complete (time)	■	■	■	❑	■	■	■
Percent complete (cost)	Reports only	❑	■	■ (calculated)	■	❑	■
Percent complete (work)	■	❑	❑	■	■	■	■
Earned-value analysis	■	❑	■	■	■	■	■
Estimates of end date	■	■	■	■	■	■	■
Estimates of end cost	■	■	■	■	■	■	■
REPORTS							
Cross-tab reports	■	❑	■	❑	■	■	■
Variance reports	■	❑	■	■	■	■	■
Number of graphic reports	4	3	4	10	3	5	4
Number of data reports	4	7	9	14	18	22	10
Status report for each worker by task	■	❑	■	■	■	■	■
Spacing control	❑	❑	❑	❑	■	■(Notes only)	■
Margin control	■	❑	❑	❑	■	■(Notes only)	■
Visible page breaks before printing	■	■	❑	❑	❑	■	■
Adjustable page breaks	❑	❑	❑	❑	❑	❑	■
Font control	❑	■	❑	❑	■	❑	❑
Mixed fonts	❑	❑	❑	❑	■	❑	❑
Customizable legend	■	❑	❑	❑	■	❑	■
FILE IMPORT/EXPORT							
ASCII	■ / ■	■ / ■	■ / ■	❑ / ■	■ / ■	■ / ■	■ / ■
.DBF	❑ / ■	❑ / ❑	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■
.XLS	❑ / ❑	❑ / ❑	❑ / ❑	❑ / ❑	■ / ■	❑ / ❑	■ / ■
.WK1	❑ / ■	❑ / ❑	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■
HELP							
Context-sensitive help	■	❑	■	■	■	■	■
On-line tutorial	❑	❑	■	■	■	■	■
Number of undos	1	1	1	None	1	None	999

Ⓒ—Editor's Choice ■—Yes ❑—No

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manipulation as you can get without a mouse. You get to see structure, time, and many tasks at once, but for anyone familiar with project management this approach will seem odd.

If you use the outline or work-breakdown chart (WBS) in *Harvard,* you have the advantage of building a project schedule with phases and summary tasks. You can have a maximum of 99 levels in an outline, but regrettably there are some problems with the interpretation of an outline or WBS by the rest of the program. Summary levels become milestones on the Gantt and PERT charts, and they appear as diamonds rather than summary bars on the Gantt and as beginning and end boxes on the PERT.

You can remove the milestones on the Gantt by using the Format menu, but they stay on the PERT, which ends up with bunches of unwanted boxes you have to remove. Another problem is that you must set all the tasks at one level as sequential or parallel when you outline. Since this may not accurately represent the flow of your real tasks, you may need to do some rearranging on the PERT.

There's a similar problem if you start to schedule in the Gantt or PERT charts. Because of these problems the best way to use the different planning methods is to set your main project phases in the outline and then go to the PERT to enter detail tasks.

Another problem with the outline approach is that time isn't summarized accurately. A top-level task will sum the durations for all the tasks under it, but it won't take into account the links, lags, and leads. So the total on the summary task form may be very far from the real total.

Since costs aren't influenced by the task dependencies, these totals are more accurate. However, they're always off by a few pennies because of rounding errors for numbers larger than six digits.

VIEWING AND LEVELING

Switching screens is fast when you use the speed key to move between active windows. Besides having two (sometimes three) windows active at once, you can split the screen horizontally in one of the windows. The split-screen view lets you combine virtually any of the single screens—a PERT chart and a Gantt chart, a cost graph and the task form, or the work breakdown outline with the resource loading histogram.

You can see only one project in a window because RAM holds only one project at a time. This has far-reaching effects. The only way to share resources among projects is to have them in the same directory. When you do this all the resources from all the projects are listed in each directory, even if the resources aren't shared. If you don't want projects to share resources they have to be put in a separate directory.

Even with projects in the same directory you can't level across them—although you can level one at a time—so you can't optimize the scheduling among the projects, and one or more schedules may get quite stretched out. The same holds true for subprojects. In addition, you can't consolidate costs for multiple projects or subprojects.

DOES HARVARD MAKE THE GRADE?

Although *Harvard* has problems with resource leveling, it does a nice job managing resources, and to a lesser extent, costs. You can have overtime costs, maximum overtime hours per day, use a resource calendar, enter a resource code, have an extended description, and record the name of the person or department responsible for the resource. You also can do partial resource allocations and enter a resource lag.

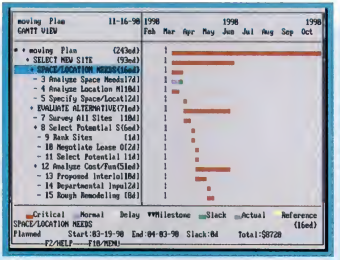
Harvard Project Manager has some fine scheduling and screen design qualities that you should consider carefully against the backdrop of the speed problems. But before purchasing it, you should have a good understanding of how this product functions.

InstaPlan 5000

Designed on the assumption that simplicity is the key to ease of use, Micro Planning's *InstaPlan 5000* is a character-based, keyboard-controlled program that uses two familiar techniques: an outline approach for organizing tasks and resources, and a spreadsheet approach for data entry. People unaccustomed to project management will be quite comfortable with this $495 program.

However, simplicity has its price, and for *InstaPlan 5000* that means the absence of activity codes, work breakdowns, and an organization breakdown structure outside of the outline. There are no start-to-finish or finish-to-finish task dependencies or resource-driven scheduling options. You also can't display detailed task information on the Gantt chart or view a complete network diagram on the screen.

Regardless of its limitations, *InstaPlan 5000* offers some sophisticated features for its price and performs faster than the average package. Supporting up to 8MB of expanded memory, it greatly surpasses the 5,000-task limit implied by its name. It also supports multiple projects, lets you set project priorities for resource leveling, saves notes containing up to 8,000 characters and organizes them by keywords, and keeps a progress history of a task. This historical information is useful for discovering trends in the project development.



This Gantt screen in *InstaPlan 5000* shows both the project outline and a task bar chart. We've highlighted a summary task, so the start and end date and the total cost for the summary task are shown at the bottom of the screen.

NO-FRILLS WORK SCREENS

InstaPlan 5000 has four main data-entry screens: Activity, Gantt, PERT, and

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Spreadsheet views. The Activity view is the best place to start building a project schedule. The left side of the screen holds the complete names of your tasks for 11 outline levels. The rest of the work area is empty except for the duration field at the extreme right. This no-frills outline screen lets you concentrate on task sequence and duration before you get distracted by other data fields. One nice touch is its ability to open or close the outline to a specific number of detail levels with one command.

SYZYGY: Project Management as Metaphor

by Henry Fersko-Weiss

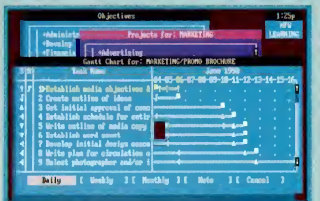
Syzygy isn't a project management package or a personal information manager—or even electronic mail. Yet Information Research's package may be the forerunner of traditional project management software in the future: a workgroup product that functions as all of the above.

It is best described as a manager of the day-to-day project workflow of a group of people. *Syzygy* gets its name from an astronomy term for the straight-line configuration of three celestial bodies. The effect isn't quite the same, but for the $695 first-user cost, you get to see a Gantt chart of tasks, consult a calendar, view a personal to-do list, and send and receive electronic mail.

Project management is commonly a standalone process. The project manager may produce reports for other people in the company, but isn't likely to be the only person who sits down in front of the program. As project management is used more frequently on networks this will change, but *Syzygy* is already there. It's intended for people at different levels of management and with different responsibilities.

Syzygy also differentiates itself because it's also a manager's product. Work-flow planning, notification, managing control, communications, and monitoring activity are all addressed. One of the most useful tools is the ability to filter information by to-do lists, resource assignments, or due dates. Because of the emphasis on managing daily work flow, there is no critical path analysis or automatic resource leveling.

There are some typical and important management functions that are commonly absent from project management software that *Syzygy* offers. When you add tasks to a project in *Syzygy*, you can indicate four crucial people: the person responsible for overseeing the task, the person notified about its status, the person who serves as a consultant, and the person who needs to approve it. The inclusion of this function explains the difference between *Syzygy* and project management packages.



***Syzygy* combines project management-style charts like the Gantt chart pictured here with more-traditional groupware features.**

MULTIPLE PROJECTS

You immediately notice *Syzygy*'s orientation toward multiple projects. The Workmap dialog box is in the first work screen. In it, you choose a macro set of projects. Next is the Objectives dialog box where you choose a more focused set of projects from a list that might read: Administrative Projects, Develop International Markets, and Manufacturing Projects. If you highlight one of these and use the Objectives button at the bottom of the list box, you drop to the next level, Individual Projects; then down one more level to the task list. This hierarchical list structure is much like a work outline, complete with plus signs to indicate the underlying detail levels.

You can enter task priorities, assign resources, and set cost rates. There is also a status column that automatically indicates if a task has been completed, is due today, has reached one of four milestones, is overdue, or not dated. The status symbols are also visible on the Gantt charts, which can show project information at the workmap, objectives or individual project level.

In addition to these features, *Syzygy* has a workgroup phone book that is automatically generated from the resource list. The program also has well-rounded electronic mail features through the embedded Message Handling Service software. The system will automatically notify everyone concerned with a task when there is a change in its status.

All the functionality in *Syzygy* is presented in a program replete with pop-up menus, list boxes, radio buttons, check boxes, and great color styling throughout the screens. Unfortunately there is no mouse support.

When project management programs begin to incorporate workgroup facilities a few years from now, they will almost certainly incorporate some of *Syzygy*'s features. True workgroup project management will probably need to present a flexible front-end—similar to *Syzygy* for departmental and front-line managers, and something more-traditional for the professional project planner. For now, *Syzygy* is the answer for group project coordination. ■

***Syzygy*, Version 1.04**; Information Research Corp., 2421 Ivy Rd., Charlottesville, VA 22901; (800) 368-3542; (804) 979-8191. **List Price:** $395; per server, $695; for each station, $150. **Requires:** NetBIOS-compatible network, 512K RAM, DOS 3.1 or later.

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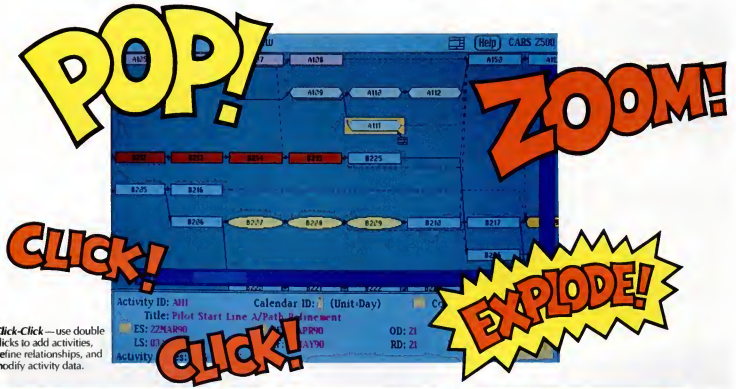
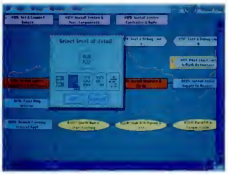
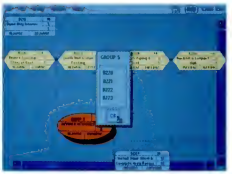
Primavera introduces some important new project management terminology.



Click-Click — use double clicks to add activities, define relationships, and modify activity data.



Zoom — five levels of detail for your network, from bird's-eye to close-up.



Explode —The Collapse command compresses several activities into one; Explode redisplays activities in their original positions.

Pop — highlights all predecessor-successor relationships and lets you click your way along any activity path.

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After you've sketched the project, you can set task dependencies with the program commands listed in the Lotus-style menus at the bottom of the Activity screen. These are entered by building up a predecessor or successor statement from command phrases on the Schedule menu. A finish-to-start link may read: "SCHEDULE [Task B] After [Task A]. Delay by [0d]."

You also can set dependencies automatically with the Auto Sequencing option so that all tasks on the same outline level are assigned a finish-to-start link. Since most tasks are linked this way you can save time by leaving this option on and changing the necessary links later on when you have the time.

FACT FILE

InstaPlan 5000,
Version 2.0
Micro Planning International, 655 Redwood Hwy., #311, Mill Valley, CA 94941; (415) 389-1414.
List Price: $495.
Requires: 640K RAM (128K or more of EMS recommended), DOS 2.1 or later.
In Short: While *InstaPlan 5000* has a somewhat simplified approach to project management, it still offers a good complement of scheduling and tracking features. It uses the outline approach to work-breakdown structure, and, depending on the amount of memory you have, you can work with up to 16,000 tasks in a project. But the program has some missing elements, including mouse support, lack of a full-network diagram display, and a limited number of task dependency types.

CIRCLE 411 ON READER SERVICE CARD

Other main work screens in *InstaPlan 5000* are split so the activity outline is preserved on the left side while the Gantt chart, network diagram, or resource assignment spreadsheets appear on the right side. This format makes it easy to comprehend schedule changes, but each view has its limitations; Gantt chart summary bars are treated the same way as regular task bars, making it difficult to differentiate between them; the network diagram shows only the immediate predecessors and successors of the task highlighted on the outline; and you can't see larger sections of the project network or change the data displayed in the activity box.

This limited network view is similar to building a house by looking only at individual room blueprints without an overall layout. Of course, you can print out a full-network diagram, but if you make frequent changes it slows you down. In the Spreadsheet view, where you can only see four or five resource columns at once, scrolling back and forth to review resource assignments is also quite time consuming.

All the main views in *InstaPlan 5000* can be filtered to focus on a group of activities or resources. The Focus command works by date, resource allocation problems, task link, and other filters, and can be saved and reused.

TRACKING AND REPORTING

Some nice tracking facilities let you enter percent complete, an actual start or end date, an estimated end date, the actual hours or cost, and the estimated hours or cost at completion. By using these parameters alone or in combination you can model the real progress of your project quite easily.

You can also calculate group task progress from individual activities by different weighting factors. For example, if one task is more expensive than the others you can give it more weight by selecting Planned Cost from the Group Percent Progress menu.

Progress data is viewed in the Gantt chart or the Spreadsheet layout, which can be changed to display different types of progress information. So, you might look at columns of actual resource hours or costs for a particular period of time or display an earned-value layout. Variance between a baseline plan and the actual project can be viewed in the Spreadsheet or Gantt chart.

The report features in *InstaPlan 5000* are restricted to preset formats for activities, resources, schedule, spreadsheet, and charts. You can pick the range of activities or resources, select data fields and control the margins, but that's the extent of the customization possibilities. There is an abundant variety of graphic reports, but the program doesn't currently support plotters.

InstaPlan 5000 is proof that design simplicity and operation aren't synonymous with abandoning a fairly good set of project management features. But compromised by some scheduling omissions, limited graphics views, and lack of control over output, it is less capable than a number of the other top products in the field.

Micro Planner for Windows

Micro Planner for Windows, Version 6.20A, offers a graphical user interface via *Microsoft Windows* and some excellent task- and resource-management facilities, but lacks some important elements. It uses an antique form of network diagramming, lacks some vital features, and relies heavily on report facilities to display information commonly visible in the work screens of other programs.

The $595 package from Micro Planning International does not include a runtime version of *Windows*; however, you can purchase it at an additional cost. *Micro Planner* looks a little better under the *Windows* 3.0 environment than it does under earlier *Windows* versions, but there are no functional enhancements.

Windows automatically bestows ease-of-use on *Micro Planner*; you control the program through the customary pull-down menus, scroll bars, and dialog boxes. With a mouse, you can virtually draw a network diagram on the screen. List boxes for resources, project phases—called zones—and responsibility designations make data entry a matter of pointing and clicking.

There are, however, some awkward aspects to the interface. Before you enter a task name you must swish the mouse pointer around under a task arrow until it turns into an I-beam, but there is no visible entry point to aim for. Some functions can only be performed from the network diagram (the panning screen). So if you're using the bar chart you can't run an analysis or use the search facilities; you must return to the panning screen first.

THE NETWORK DIAGRAM

Most of the scheduling work in *Micro Planner* is accomplished through the panning screen, which uses the "activity on arrow" style of the network diagram. This format is much less popular today than it was years ago. Recognizing this, Micro Planning will include the more-common "precedence" network format in its next upgrade and allow users to convert. This ability is already built into Micro Planning's *Expert* package for the Macintosh.

The activity on arrow format is confusing unless you're used to it. Activities are

FACT FILE

***Micro Planner for Windows*, Version 6.20A**
Micro Planning International, 655 Redwood Hwy., #311, Mill Valley, CA 94941; (415) 389-1414.
List Price: $595; network version, $299 per network user.
Requires: 640K RAM, DOS 2.0 or later.
In Short: *Micro Planner* runs under *Windows*, which gives it a nice graphical user interface. The program also handles resource management well, but it uses the unfamiliar activity-on-arrow PERT chart, has a poor Gantt display unless you print a Gantt report to the screen, and no on-screen help. If you're a devotee of its form of PERT chart, the package may be worth considering. Otherwise, look elsewhere.

CIRCLE **412** ON READER SERVICE CARD

the arrows between beginning and end events, represented by circles. To make some logical links in a schedule you have to use dummy tasks, which clutter up the diagram. In the end, the diagram looks like a blueprint for a sewer system. To make matters worse, the diagram in *Micro Planner* only shows one activity in the center of the screen surrounded by its immediate connections. Rather than scrolling through the network, you jump from task to task, or task to event, by clicking the mouse on the arrows running off the screen. If it weren't for the string search command, you might never find some tasks.

The only way to see a more complete network diagram is to produce it through the reporting facilities. You can scroll through or zoom-in once with the Reduce To Fit option, but there's problem with this approach. Since the report version of the network diagram isn't interactive, you can't add tasks or edit the existing ones. The bar chart report has the same static view problem, yet it's a much more attractive chart than the one on the View menu. You can also see task information in columns to the left of the bars. The normal Gantt view does not show task information on the screen except for the task name written through the bar. Breaking up the solidity of the bar this way is very distracting, and you can't see many tasks at one time because the bars are so thick.

While *Micro Planner* relies heavily on its reports, the program gives little control beyond the content. You can select the font style and size, which is also one of the ways to control the overall size of the report. You can scale a graphic report, but you can't directly set margins or spacing, move page breaks, customize the legend, use grids, shading, or any other styling techniques.

RESOURCE MANAGEMENT

On the positive side, *Micro Planner* offers some sophisticated scheduling and resource management abilities. For example, activities can be any one of ten different types, two of which assist you with fine-tune resource leveling. A Consecutive task may not be delayed or split during resource leveling once it has started, whereas a "Non-Split" task can be delayed but not split under the same circumstances.

Resource leveling in *Micro Planner* can only occur after you've done a time analysis—that means calculating the schedule. Resource leveling can be done within a float or by pushing the project end date. With the latter type of leveling, the program will split activities and produce a more efficient schedule. Leveling can be fully automatic, or you can ask the program to prompt you for a decision every time it encounters an overloaded resource.

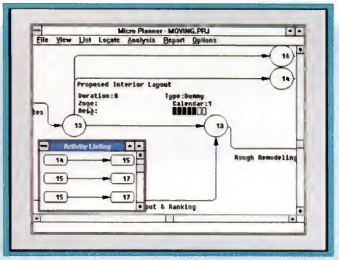
The resource management in *Micro Planner* is surely its best feature; it offers great flexibility. Resources can be normal or pool. A normal resource is available every day for work, while a pool resource is consumed (bricks or screws, for example). You can specify 20 different quantities for a resource based on dates when a change will occur. When you assign resources you can specify start and end days, and the quantity available. You're limited to only 26 resources per project and 20 per task.

While *Micro Planner*'s resource management is strong, it is overshadowed by holes in the package's feature set. The only task durations you can enter are days and weeks, and you can't make notes on tasks or the project. You also can't do an earned-value analysis and there are no variance reports or on-screen help facilities. And finally, import/export facilities are limited to ASCII and DIF. The impact of these missing elements is compounded

HOW WE TESTED THE SOFTWARE
The PC Labs performance tests for project management software were conducted on an IBM PS/2 Model 70 configured with 4MB of extended memory (optimized as extended or expanded memory depending on the vendor's specifications), a VGA display card, and a 100MB hard disk formatted with IBM DOS 3.3.

The tests were timed from the moment the key was hit to start the test until keyboard control was regained. Some programs have different ways of handling these tasks—via several sets of commands or more than one set of keystrokes. In the case of several sets of commands, the cumulative times of all the system activity for each step was measured and recorded. The average results of three test runs are reported.

THE PROJECT
The project we used for these tests had 89 tasks and 19 separate resources. We created a hypothetical situation that a typical corporation might encounter: relocating a corporate office, all the way from performing a feasibility study of the move to the grand opening of the newly settled office.



In *Micro Planner for Windows* only the central activity can be opened and edited. To scroll through the project you must centralize the activities at the edges of the screen. Here, the Activities Listing box is open. It shows the activity arrows with their start and end event numbers.

PERFORMANCE TESTS: LOW-COST PROJECT MANAGEMENT SOFTWARE

Most inexpensive project management packages perform similarly on PC Labs' tests, though aberrations are found where disk access is heavy or sophisticated algorithms are used for resource recalculation.

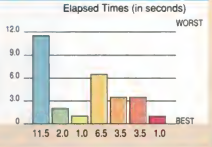
The **Load Project** test measures the time it takes to load the office project and allow the user to access the options menu from the native operating environment.

The **Time Resource Change** test measures the time the package takes to recalculate the project summary when a major resource's schedule is modified. In our scenario, the Operations Manager of the move had just turned 60, and it was company policy that all employees aged 60 or over had every Friday off. We measured the time it took to assimilate that change into the project.

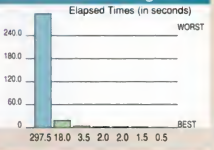
The **Add Tasks** test measures the time the package takes to recalculate the project's structure after more tasks are added to it. We pretended that at the very end of the "Lease New Site" task, the closing fell through. The board of directors rejected the proposal and they mandated working with the next realtor on their contingency list. It took eight business days to contact the contingency leaser and arrange a meeting. The "Lease New Site" set of tasks process is repeated again. We measured how that change would impact the project's completion.

The **Cost Resource Change** test measures the time it takes to recalculate the estimated cost of a project after selected resource costs are modified. The unions finished negotiating, and the first five resources from the end of the "Lease New Site" module will cost 20 percent more.

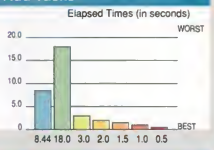
Load Project



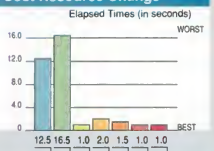
Time Resource Change



Add Tasks



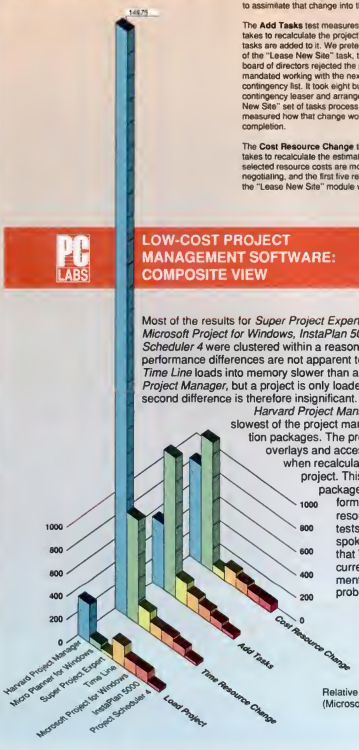
Cost Resource Change



LOW-COST PROJECT MANAGEMENT SOFTWARE: COMPOSITE VIEW

Most of the results for *Super Project Expert, Time Line, Microsoft Project for Windows, InstaPlan 5000,* and *Project Scheduler 4* were clustered within a reasonable range; the performance differences are not apparent to a typical user. *Time Line* loads into memory slower than all but *Harvard Project Manager,* but a project is only loaded once, and a 3 to 5 second difference is therefore insignificant.

Harvard Project Manager was by far the slowest of the project management application packages. The program swaps lots of overlays and accesses the disk often when recalculating the output of a project. This explains the package's terrible performance on the two resource recalculation tests. A company spokesperson stated that Version 3.02, currently under development, should rectify this problem.



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In the rest of this proposal, we present a complete program tailored to the needs of The Nicholson Corporation. This program features a wide variety of destinations including Tahiti, the Caribbean and Hawaii.

But before we get into details, the next page will present some pertinent statistics on how companies similar to yours have achieved major sales goals with the help of Sales Away Incentives, and some projections to show you what The Nicholson Corporation can expect.

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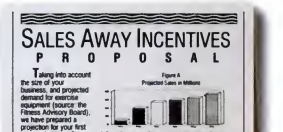

SALES AWAY INCENTIVES
PROPOSAL

Taking into account the size of your business, and projected demand for exercise equipment (source: the Fitness Advisory Board), we have prepared a projection for your first six months in the Sales Away incentives program.

As you can see in figure A, your sales will increase by more than 200% over the period. Using these projections, you will be able to plan increased production to meet increased demand.

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To back up this assertion, we have prepared a table of month-by-month sales increases in companies that have used similar programs (Figure B).

Of course, the real benefits of a Sales Away incentives program cannot be expressed in numbers alone. Besides becoming more productive during the program period itself, winning employees tend to sell more when they return from their cruises. They experience greater levels of satisfaction, and exhibit better morale. Also, they tend to become more loyal to the company, and employee turnover rates typically decrease after a Sales Away incentives program.

Figure A
Projected Sales in Millions

Figure B - Actual Sales in Millions

	Jan	Feb	Mar	Apr	May	Jun
Flex Corp.	150	175	180	277	352	415
Cornell Inc.	317	314	412	399	512	512
Great Bird Co.	1810	1812	1916	1768	1800	2114
Mt. Beaver	62	125	113	175	211	365
Rocket Inc.	63	73	118	161	253	303

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by the awkward and somewhat difficult network diagram, and the program's relatively slow speed. With luck, the next release of the package will address these inadequacies.

Microsoft Project for Windows

After using *Microsoft Project for Windows,* Version 1.00, it's hard to imagine project management any other way. You can enter, edit, adjust, format, and view data in so many ways that it's like molding projects with your hands. You can view the results interactively, which turns project management into the visual discipline that it is. But the beauty of *Project for Windows* is in the richness of its project management facilities—scheduling, tracking, and reporting—all for $695.

LINKING VIEWS AND DATA

The tremendous data-viewing flexibility that *Project for Windows* offers is its most impressive feature. There are 11 standard view screens including Gantt and PERT charts, worksheets for viewing information on many tasks or resources at once, and forms for looking at one task or resource. All task worksheets use the outline method of organization.

Two views can be seen together on a screen that is split horizontally, and you can mix the views anyway you like. This capability is quite exciting because you can juxtapose information never possible before—such as a Gantt chart over a PERT chart, or a Resource Usage worksheet over a histogram. Each of these combination views helps you view a project in a different way, and the more ways you have to examine and track a project the better you can understand and control it.

Information in the bottom window is dynamically related to the cursor position in the top pane, so even switching the order of the views in the top and bottom window panes gives you a slightly new perspective. For example, with the cursor on Task A in a PERT chart, the Resource Usage worksheet below will display the resource allocations for Task A alone. If the Resource Usage worksheet is in the top pane of a combination view, it will show all the resources and work hours over the length of the project—like the numerical equivalent of a histogram.

You can save single and combination views that you find useful and place them on the View menu, and you can create your own views by using sophisticated filtering techniques, selecting the data fields you want in the worksheet views, or changing the fields in the form views.

Project for Windows comes with a set of worksheet layouts (called tables) and filters that you can use or edit. They help you focus on costs, resource allocation, variance or other project elements while filtering on critical tasks, tasks in progress, and so on. You can also define new tables and filters.

NEARLY TOTAL FREEDOM

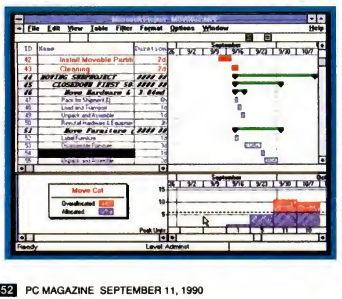
Your ability to customize views doesn't end with the content. You have control over the width of worksheet columns, titles, colors and grid lines, box treatments, bar chart styles, fonts, type styles, and point sizes of text. All of this may sound overwhelming—nearly total freedom often does—but when you work with *Project for Windows* the views are simple and obvious.

Part of what makes *Project for Windows* easy to use is its operational tricks and graphical commands that make entering data and updating the schedule very fast. There are icons for opening the form, linking tasks, promoting or demoting tasks in an outline, and expanding or collapsing summary tasks. The form and link icons can be used to add the same information to a whole group of marked tasks or resources. With the mouse you can stretch or move Gantt bars, widen table columns or increase row heights, assign predecessors or resources, and create new boxes on the network diagram

The *Windows* environment magnifies power and flexibility by allowing nine windows to be active at once—each with its own customized combination view of a different project—making multiple project management much easier. You can also cut and paste data, including graphics, from *Project for Windows* into a word processor and use the macro facilities found in *Windows* 3.0. The program comes with a runtime version of *Windows* 2.11 but will run even better with the improved memory management of Version 3.0.

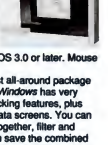
SCHEDULING AND TRACKING

Project for Windows's appeal goes well beyond the glitter of its interface and the



***Microsoft Project for Windows* lets you create a great variety of combination views like this Gantt chart with a histogram for the Moving Cost resource. It's easy to bring in different fonts and point sizes, to color the summary bars green, and to add different patterns to the Gantt bars.**

FACT FILE
EDITOR'S CHOICE



***Microsoft Project for Windows*, Version 1.00**
Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; (800) 426-9400, (206) 882-8080.
List Price: $695.
Requires: 1MB RAM, DOS 3.0 or later. Mouse recommended.
In Short: Clearly the best all-around package in the group. *Project for Windows* has very good scheduling and tracking features, plus excellent graphics and data screens. You can also mix any two views together, filter and customize them and then save the combined view for later use. You can completely control the formats of the screens and reports from the font type and size, to the colors, bar styles, grid lines, shadow boxes and so on. This program will set the standard until a better *Windows* or Presentation Manager project manager comes along—if one does.

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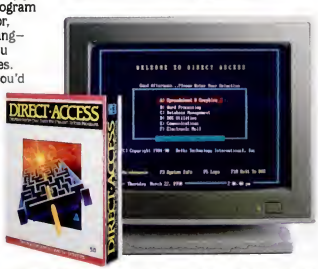

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malleability of its project views to include quite a good set of scheduling and tracking features. A prime example is the way tasks are treated. They can be controlled by the duration (entered as work time or elapsed time expressed in minutes, hours, days, or weeks) or by the resource allocation. Start and end dates can be entered as scheduled, planned, or actual, and tasks can have various time constraints, such as ASAP (as soon as possible), ALAP (as late as possible), "start on," or "end no later than." Plus you can designate a task as a subproject, give it a priority, and assign a work breakdown structure code.

Resources can be defined as completely as tasks. Each resource can have its own calendar so you can vary the hours a resource is available on any day, change its work week, and establish off days. You can give a resource a group designation, an RBS code, entry initials, and set a standard rate, overtime rate and per use cost. Costs can be applied at the beginning or end, or prorated over the duration of the task.

For tracking the progress of a project you can use percent complete or actual duration to control the updates. Or you can turn the Auto Track Resources off so that actual work hours and costs are uncoupled from the progress of a task in time. Comparisons between the original project plan and actual progress can be seen on the Tracking Gantt chart or in the task and resource worksheets. Reports can be printed directly from the view screen or through a set of five reports—such as Periodic Resource and Project Summary—which you can customize the same way you customize tables and filters. *Project for Windows* supports many printers and plotters through Windows.

The few weaknesses in the program are in the cost management area. You can't enter overhead costs on a task or inflation rates for resources. You can't display or print a cost curve or be precise about the timing of resource assignments. The program also lacks a project priority field for working with multiple projects. The program could be faster, although under *Windows* 3.0, its performance is far better than under earlier *Windows* versions.

Project for Windows manages to combine a splendid graphical interface with true viewing flexibility and outstanding project management features. It's an amazing performance by Microsoft when you consider how far the company has come from its earlier, character-based product of nearly the same name. No package in this price range is better all-around.

Project Scheduler 4

When Scitor's *Project Scheduler 4* came out two years ago it offered the first appealing graphics-based approach to project management. Version 2.0 has added expanded memory support and improved multiple project scheduling and reporting facilities at the price of $685.

PS4's proprietary graphical interface closely resembles that of *Microsoft Windows*—black text on a white background, pull-down menus, scroll bars, dialog boxes, and pop-up lists. One important difference is that *PS4* is very fast—so fast that recalculating a project

EASY PLANNING WITH PROJECT OUTLOOK

by Henry Fersko-Weiss

Suppose you want to schedule activities and monitor progress on the way to a distant deadline without bothering to factor in resources and costs? You can buy project management software and ignore most of its features, or you can use paper, a pencil, and ruler. But there is another alternative: Strategic Software Planning's *Project Outlook for Windows*, which offers a number of advanced scheduling features.

The package has critical path analysis, a number of code fields, an actual versus planned Gantt chart, undates by percent complete and more. In addition, *Project Outlook* offers all the interactive control and formatting advantages that come from running under *Windows* 3.0. So for $395, you can get just what you want—a good project scheduler. If you ever want to do more, you can upgrade to SSP's *Pronis*, a complete high-end project management package.

The two main views in *Project Outlook* are the outline screen and the Gantt chart screen. An outline can be 16 levels deep, and you can hide and reveal levels as you choose. When you switch to the Gantt chart you'll see summary bars stretching over the detail tasks under them to visually represent the outline. Summary bars are thinner and have bracketed ends. If the detail level under a summary is hidden then the summary bar has an arrowhead icon inside it.

You can link together tasks on the Gantt chart in two ways: via the pull-down Create menu and the Link dialog box, or the Add Link icon in the toolbox. These are the two principal ways of commanding *Outlook*. The toolbox has ten command icons which let you operate *Outlook* interactively. For example, with the Add Link icon you simply click on the ends of the tasks you want linked and the dependency arrow is drawn between them.

Project Outlook has a full complement of task-scheduling capability—ASAP, ALAP, or fixed date, and you can use any of the common task dependencies except start-to-finish. You also have control over the critical path analysis. You can use task date constraints or ignore them, use a deadline date for backward scheduling, or use multiple critical path analysis, and allow for out-of-sequence updating. When updating a schedule, you can enter actual dates and percent complete. The one weakness in the scheduling capability is the need to set all task durations in days.

In addition to scheduling, *Project Outlook* has a number of clever tricks, such as date, link, baseline, and other forms of automatic tracing.

But, if you want only to schedule and monitor tasks, then *Outlook* has all the advanced project management techniques you'll need. ■

***Project Outlook*, Version 3.0**, Strategic Software Planning Corp., 150 Cambridge Park Dr., Cambridge, MA 02140; (617) 354-1504. **List Price:** $395. **Requires:** 640K RAM (1MB recommended), *Microsoft Windows*, DOS 3.1.

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schedule is automatic. There is no way (and no need) to turn it off, and moving from screen to screen is ultra fast, even on a 286-based PC with only 512K RAM.

PS4 divides its commands into two areas, with system-wide commands appearing on the main menu bar and window-specific commands on secondary menu bars at the top of the window. This design makes finding the right commands easy and lets you do nonsynchronized work in two windows at once. The program also has context-sensitive help and three levels of automatic prompting.

Most of the project scheduling and tracking is done in work screens—the Gantt chart, network diagram, and job list—that are split views with two horizontal windows. So, for example, in the Gantt chart the lower window can hold a resource histogram or one of four data entry templates: jobs, resources, predecessors, or notes.

All the charts and graphs in *PS4* are clean, simple, and quite pleasing. Although you don't have much control, the program uses a nice selection of bold colors for borders and the typical red and blue for critical and noncritical tasks. In addition to the Gantt, PERT, and histogram views, you can view a cost curve.

Up to five columns of data can be displayed on the Gantt chart—including dates and resource columns new to Version 2—giving you some flexibility. But the task bar area can get squeezed and become useless as you add data columns. For example, if you display the WBS code, job name, resources, and task dates you are left with such a narrow view of the bars that it's like trying to survey an entire room by peeking through the keyhole of a closed door.

The PERT chart has four levels of zoom beyond the normal view. You can go from a highly detailed, but restricted view, to a view of the whole project structure—as if you were looking at a collection of connected houses from 30,000 feet up.

SCHEDULING FEATURES

High-quality scheduling capabilities allow you to schedule projects from a start date or an end date, and to adequately define tasks with durations in minutes to weeks with lead or lag times. WBS and OBS codes are not automatic, but you can assign both by entering codes on each task, a tedious step if you're working with many levels. Since *PS4* doesn't use outlining or summary tasks you have to filter on different levels of the WBS code to produce summary views of your project.

The uncommon pluses of the program include the ability to set a date required on a task and to enter a delay time. The date required is used in forward scheduling as a target date for the latest possible end of a job. If the schedule constraints would cause a task to end later than this date, you would see a negative float displayed on the Gantt chart. The delay time prevents a job from starting for a period of time after all the dependency constraints have been met. You might enter such a delay because you know a critical resource is suddenly unavailable.

Another uncommon feature is the ability to set up to five inflation cost schedules. Each schedule of percentage increases is tied to a maximum of 12 dates and you can apply one of these inflation schedules to any resource.

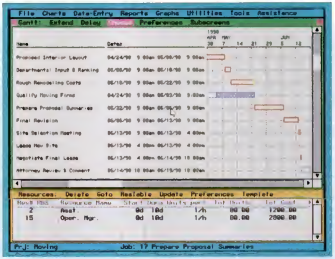
PS4 lets you enter a resource code and assign it to a specific part of a job. By using the start and duration fields on the resource assignment form you can have a resource start *x* number of days after the start of the job and keep working for *x* number of days. By assigning resources more than once to a task, you can define a complicated work schedule.

The program has resource calendars used only to indicate days off so you can't change the work hours for a resource. These are set on the project calendar and, unfortunately, applied uniformly. So, if you set the work hours as 9:00 A.M. to 5:00 P.M., that's what they'll be for each work day. You can't have a long day on Thursday or a half day on Saturday. This restriction can make it hard to model some work situations.

REPORTS AND TRACKING

The primary method of updating a baseline schedule is to enter the percent complete of the task. This field on the job template assumes the job started on time. If not, you can move a start date forward so that it matches the percent complete as of the present date or keep the start date but stretch the duration. Neither of these approaches is totally satisfactory since you are unable to enter an actual start date. Actual resource use and costs can be entered and uncoupled from the percent complete, which lets you get more-precise progress information in reports.

Reports are one of the main tracking tools, another way to analyze the schedule



Project Scheduler 4 **uses its own graphical user interface, a white-background screen, scroll bars, pull-down menus, and dialog boxes. At the bottom of the Gantt chart you can display data entry forms. This form is used to allocate resources.**

FACT FILE

***Project Scheduler 4*,**
Version 2.02
Scitor Corp., 393 Vintage Park Dr., #140, Foster City, CA 94404; (415) 570-7700.
List Price: $695.
Requires: 512K RAM, DOS 2.0 or later. Mouse recommended.
In **Short:** *Project Scheduler 4* is an extremely good package with its own graphical user interface. The screen design and interactive nature of the package make it easy to learn and use. It gives you the ability to see project data and graphics together in nicely laid out screens, has thorough scheduling and tracking abilities, and is quite fast. If you want a program with a graphical user interface but don't want to get involved with *Windows*, this is the right package for you.

CIRCLE 414 ON READER SERVICE CARD

and present this information to other people. *PS4* has an ample number of text and graphic reports, but their structure is predetermined. You can, of course, change the range and to some degree the kind of data, but you still must work within a confined format that restricts control over the output design. You can't change colors, fonts, border treatment, or layouts. One of Version 2.0's new features is the ability to generate all these reports for multiple projects. Multiple project support has been beefed up in other ways as well. You can now do resource leveling across projects, see a multiple project histogram, and manage more tasks. With support for up to 8MB of expanded memory you can increase the number of tasks from between 1,200 and 1,500 in a 640K system to about 6,000 tasks per additional megabyte.

Though *Project Scheduler 4* hasn't changed much in other ways over the last two years, its graphical interface and speed keep it near the top of the field. While it lacks flexibility in its formatting and is missing a few scheduling and tracking niceties, it can satisfy the needs of most project planners.

Super Project Expert

Computer Associates' *Super Project Expert*, Version 1.1, has very comprehensive scheduling and tracking facilities for a project management program in the low-end category. The $695 program includes basic scheduling features plus task priorities, duration deviation, true PERT analysis and tracking of actuals independent of percent complete. No program can allocate resources as precisely as *Expert* can. However, its features are somewhat obscured by the program's awkward interface, slowness, and rather weak on-screen graphics.

Expert comes with the mode of operation set to Beginner. In this mode you can only link tasks in a finish-to-start relationship; you can't produce any reports other than screen dumps, and features such as cost accounting, tracking of actuals, and leveling by priority are all turned off.

The other two operational modes, Intermediate and Expert, list exactly the same features, but the Intermediate features are almost exactly the same as those of the Beginner mode. Considering the small differences, having both an Intermediate and Advanced mode seems unnecessary.

However, there are some advanced preferences you need to access through the Edit menu. It seems ungainly to have to set preferences to use certain features. And it's hard to imagine serious project management without costs or actuals, but only in Advanced mode are these automatically enabled.

PLANNING FOR UNCERTAINTY

You control *Expert* through pull-down menus, preference settings, and speed keys, but the lack of mouse support tends to slow operation down a bit. Task and resource data can be entered on several different screens; some are graphic, such as PERT, Gantt, and WBS charts, and others are tables or forms. The program uses the outline technique in addition to WBS for structuring the sequence of tasks. The outline screen is the most comprehensive because in it you can view tasks relating to each other. By picking and arranging data columns you can see virtually all you need to know about a task.

You schedule tasks in hours, days, or weeks. But since durations are always approximations or guesses, *Expert* lets you model for uncertainty by entering a duration deviation or an optimistic, likely, and pessimistic range. If you enter one, *Expert* will calculate the other. Duration probability has to be used with caution. It does not take into account resource availability or conflicts, so the resulting schedule can be inaccurate. It also slows the program down, which is a serious drawback because *Expert* is already slow at scheduling and resource leveling. Part of the reason for this slowness is that the program optimizes the schedule. Its leveled project schedules tend to be shorter than those produced by other programs because *Expert* eliminates the gaps in resource use. In fact, the resource leveling in *Expert* is quite clever, and its slowness is the trade-off for its accuracy. If you enable the split resource assignments option the program will interrupt a resource assignment at the point of conflict rather than delay a task completely. Thus, the resource can work on a lower priority task until it is needed on a higher priority task. If you use this approach, however, you have to enter a priority for every resource assignment— quite a time-consuming chore.

FACT FILE

***Super Project Expert*, Version 1.1**
Computer Associates International Inc., 711 Stewart Ave., Garden City, NY 11530; (800) 531-5236, (408) 432-1727.
List Price: $695.
Requires: 512K RAM, DOS 3.1 or later.
In Short: *Super Project Expert* is chock full of features including some unusual techniques like duration deviation, true PERT analysis and different levels of operation according to experience. It also has excellent resource-allocation facilities. But its on-screen graphics are poor and it's a little hard to get at all the functionality. Consider this program only if your main concern is scheduling and tracking data, and charts and diagrams are less important.

CIRCLE 415 ON READER SERVICE CARD

Resources in *Expert* can be thoroughly defined by entering a work code; accruing costs at the start, middle, or end of an assignment, setting a total number of extra hours the resource can work in a week, and indicating an overtime rate.

One of *Expert*'s shining qualities is the ability to distribute a resource's daily hours. You can assign a resource to work on a task for part of its available workday, leaving it free to work on another task on the same day. To do this you enter the number of hours or a percentage. You can also assign a resource to work on a task for a specified number of total hours or days less than the task's duration. And the assignment can be delayed to begin any time after the task starts.

GANTT AND PERT

When it comes time to track the progress of your project, *Expert* lets you use percent complete or enter actuals for hours and costs, or start and end dates. The percent-complete field is automatically used for hours, but you can use it for costs by overriding the automatic calculation and entering a manual percent complete. This field is then used to calculate the Budgeted Cost of Work Performed (BCWP), which also appears on the task details screen. Naturally, one of the best tracking tools is the planned-versus-actual Gantt chart. While this chart is fairly clear in *Expert*, the black background, boxy bars, and arrowhead float symbols give it a somewhat primitive feel. It also can be a bit confusing to read since the bars are repeated under each other for every resource unless you take

The numbers outside.

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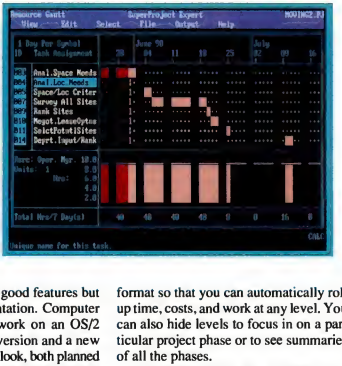
the time to remove the resource column.

In general, the graphics in *Expert* are poor. The PERT chart lets you see no more than five task boxes at once, and the connections between task boxes are often very unclear.

If you use the zoom option on the PERT chart you immediately go to task boxes that are big enough to show only the task ID number and the diagram looks like an astral map. If you go to the next level of reduction the patterns just compress, and the view is totally useless.

The most understandable and attractive graphic images in *Expert* are the project and resource calendars. You can see five weeks at a time with the number of daily hours displayed at the top of the day column. Entering irregular hours, vacations, holidays, and other nonwork days in any date cell gives you tremendous flexibility.

Super Project Expert is one of those programs that has very good features but is flawed by the presentation. Computer Associates is hard at work on an OS/2 Presentation Manager version and a new DOS version with a PM look, both planned for release in the fall. If all goes according to plan, these versions should address the problems.



***Super Project Expert*'s Histogram/ Resource Gantt view shows the histogram for one resource. Here you can see if the resource is over allocated. At the top of the screen is a Gantt chart showing only those activities to which the Operations Manager is assigned.**

Time Line

The fourth version of Symantec's *Time Line* maintains a difficult balance between rich features and ease of use—twin goals that have distinguished this package from competitors since the beginning. The most exciting addition to *Time Line* is the excellent presentation graphics output facility. You can now create stunning charts and print them to a wide variety of printers, plotters, and film recorders. The baseline Gantt with its overlapping bars is particularly attractive. With earlier versions of *Time Line*, you had to buy a separate $195 graphics package. Now you get much better graphics for a $100 increase in *Time Line*'s cost, bringing the total to $695.

Enhanced operational use makes the heart of the package—the Gantt chart screen—more accessible. This is where you build your project schedule and do most of your tracking. You can now edit task data directly in the chart, use a mouse, and build extensive macros. The screen is split into a spreadsheet on the left and a bar chart on the right. In the spreadsheet area you list the project tasks in an outline format so that you can automatically roll up time, costs, and work at any level. You can also hide levels to focus in on a particular project phase or to see summaries of all the phases.

Columns of task, cost, or resource information are alongside the task list, which can have as many levels as you want it to. Finally, task bars are on the right. *Time Line* uses color schemes and bar symbols quite effectively to create an easy-to-read chart.

Symantec has also added a few refinements to the project management facilities so you can draw both an outline and the more-traditional PERT chart, automate any WBS format, do resource leveling within slack, and schedule resources by the hour.

FACT FILE

***Time Line*, Version 4.0**
Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; (408) 253-9600.
List Price: $695.
Requires: 640K RAM, hard disk, DOS 3.0 or later.
In Short: *Time Line* has maintained its excellent balance of rich features and operational ease. With its added mouse support and its ability to use expanded memory and resource smoothing, it has shored up the few holes it had in scheduling and tracking. The package now includes stunning output graphics with a full-WYSIWYG preview. If you have absolutely decided not to get a package with a graphical user interface, then this is the character-based package you should put first on your list.

CIRCLE 416 ON READER SERVICE CARD

STANDARD AND CUSTOM LAYOUTS

Time Line's special Layout function lets you customize the information and, to some extent, the appearance of the Gantt screen with a number of standard layouts. For example, the Tracking layout has columns for Start Date, Duration, End Date, Percent Achieved, and Start Date Variance. Other pre-set layouts let you focus on cost information, resources, progress, or just dates and durations.

You can also design your own layouts by choosing up to 16 columns of data from a selection of over 100. And there are 20 auxiliary fields you can define for your own use. These layouts can be named and placed on the layout list for future use.

There are several other functions that make *Time Line* a great program for what-if analysis. You can change from one layout to another easily and scroll through column and bar chart areas independently with the mouse. Plus you can expand the spreadsheet or bar area to see more of one side or the other. To call up task forms for editing, you just double-click on the task bars. You can further customize the screen by using filters to select or highlight tasks. You also can display up to five resource histograms along the bottom of the Gantt screen, and you can undo and redo up to 999 operations.

FLEX SCHEDULING

Time Line does a thorough job of scheduling and tracking a project. You can set durations in minutes, hours, days, weeks, months, or fractions of these durations. Tasks can be linked in any conceivable relationship, including start-to-finish, and

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PC Magazine [July 1989, Page 263]:
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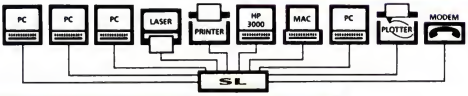

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CIRCLE 328 ON READER SERVICE CARD

you can schedule forward or backward.

There are two task forms, one for simpler projects and one for tracking achievement, expenditures, coding, setting priorities, and linking schedules. With the long form you get WBS and OBS code fields. There are two percent complete fields—one for work achievement and one for dollars spent. You can assign up to 24 resources or costs per task form.

Resources can be defined with a default assignment of so many units at a certain percentage. Resource leveling can be done within slack or in the more-usual way that pushes the end date when necessary.

There are several different assignment forms: resources, fixed cost, unit cost, and variable cost. Resources can be allocated for a percentage of effort, which is spread out evenly over the task duration. This is something of a partial assignment, but you can't specify on what day a resource will start work or for how many days it will work. Another weakness in *Time Line* is the inability to indicate inflation rates for costs. Perhaps the biggest missing resource element is the lack of resource calendars. With expanded memory support you can now manage more than 1,000 tasks. In previous versions, you could run out of memory very quickly, which limited the functions or the number of tasks you could handle.

The Gantt chart in *Time Line* is where most of the scheduling and updating work occurs. The left side of the screen holds the project outline and columns of data. You can select up to 16 columns from over 100 fields. The layout can be saved and reused.

POWERFUL MACROS AND GRAPHICS

There are a host of other project management features that set this product apart. You can see two or more projects in the outline mode by splitting the screen, place unlimited notes on tasks, resource/cost forms, do cross project leveling, produce an array of text reports, and import or export data to and from *Lotus 1-2-3*, *Microsoft Excel*, *dBASE*, and ASCII files.

The macro facilities in the program are so powerful you can virtually build applications with them. In fact, *Time Line* comes with two extensive prerecorded macro routines, one for quickly generating a schedule and the other for producing quick graphic output.

The new output graphics in *Time Line* are probably the best available. You can control the font size, use proportional spacing, choose colors for every aspect of a chart—including the background, use rounded corners, change line thickness, customize the titles and legends, annotate the chart, and use special symbol sets.

Time Line is still a character-based program, but you can see a WYSIWYG preview of your output before you print and zoom in on a section for a close-up. The program tells you how many pages the printout will take across and down. Charts can be scaled manually up or down in size to change awkward page breaks, or they can be forced to one page. Symantec has also rewritten the printer drivers, including PostScript printers and devices for producing 35-mm slides, color overheads, and transparencies.

Time Line is one of the best-balanced project management programs available. Its faults have more to do with its character-based nature than with holes in its functionality. If you're not absolutely sold on a graphic user interface, and you want power with ease of operation, this is the program to put at the top of your list. ■

Henry Fersko-Weiss *is a contributing editor of* PC Magazine.

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by
Luisa Simone

Lab Notes

Bring Your Business Presentations to Life with Autodesk's Animator

Seeing their first *Lotus 1-2-3* bar chart was enough to show business users how effectively PC-generated graphics could turn ordinary facts and figures into compelling arguments. Those first crude images have since been enhanced by higher video resolutions, vibrant color, 3-D effects—and now—movement.

Nearly every business presentation provides opportunities for effective animation. When two successive slides show profits down for Q1 and up for Q3, for example, the message is that net income, represented by a bar, has risen over time. *Animator,* from Autodesk, explicitly reveals the motion that otherwise remains only implicit in business graphics—for display on a VGA monitor or for translation onto videotape.

Using a simple icon- and menu-driven interface, *Animator* puts sophisticated interactive animation tools into the hands of the average business user. And at $299, *Animator* costs less than most charting and graphing programs. The difference, of course, is that such business graphics programs as *Xerox Presents* or Lotus's *Freelance Plus* create finished, if static images from numerical data. Dressing up the resulting pie or bar chart usually involves nothing more than choosing a piece of clip art from a library.

But even the corporate user who recognizes the inherent communicating potential of animation must overcome the perceived barriers of generating images from scratch and scripting motion. This article will explain some of the important features of *Animator*'s toolset and provide some basic illustrations of how to use it with ancillary programs.

■ The ability to add motion to static chart displays gives you a powerful tool for getting your message across.

BEGINNING WITH THE BASICS

On its most basic level, *Animator* can be described as a two-dimensional painting program that can perform imaging functions over time. With a few simple menu choices and a mouse, you can indicate the path along which a cel (or image) will travel. Then enter the number of frames *Animator* should use to implement the motion and you can sit back and watch as the program does the rest.

When you attempt a more detailed explanation of the program, however, linear descriptions break down—and for good reason. *Animator* is structured as a series of independent code segments linked by gateways. This organizational foundation makes it possible to access essential functions, such as the Time Select panel, shown in Figure 1, from within any other portion of the program.

Each time you pass through a gateway into a different part of the program, *Animator* saves the current state and loads the necessary new code into memory. The number of states that can be stacked is dependent upon the amount of free memory: hit the limit and the program will crash. While working with the program, then, if you get the feeling that you might have lost your way in a series of operations, be aware that the stack may be dangerously near full. The practical remedy in such a situation is simply to right-click on the drawing screen, which has the effect of exiting all the way down to the base layer of your animation.

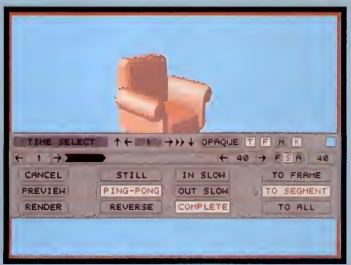

Figure 1: You can use the gateway to reach the Time Select panel from within any other module in *Animator*.

Figure 2: In the first animation demonstration, a simple text message scrolls up the screen while a piece of three-dimensional clip art twirls in space.

THE THIRD DIMENSION

Most business presentations involve word charts, technical diagrams, and graphs of numerical data. The premise of our first animation sequence, therefore, is that kinetic clip art can dramatically improve even the simplest text message. Here, as seen in Figure 2, we have a straightforward word chart that discusses the revenues architectural firms can realize by offering interior design services to their clients. The rotating chair is certainly related to the interior design theme, and it keeps the viewer's interest.

To create the illusion of a chair spinning in three-dimensional space, you must first generate a series of two-dimensional images in which each image shows the chair from a slightly different angle, as shown in Figure 3. You could, of course scan a series of photographs of a chair, in which case you would only need to use *Animator* as a linking tool. A second option would require painting each view of the chair, using a program such as ZSoft's *PC Paintbrush IV* or *Deluxe Paint II Enhanced*. Unless you have the talent and resources of the Disney studio, however, this option isn't really feasible.

A high-end CAD program like *AutoCAD*, with *AutoShade*, has the power not only to render a true 3-D object, but also to plot a path around it, saving individual files for each view. Still, however, asking a typical corporate user to become a CAD expert seems as extreme as asking him to become a professional illustrator.

The low-tech solution I adopted required only a little ingenuity, a lot of elbow grease, and a 3-D clip-art program. *Clip 3D* and its companion 3-D modeling program *Zing!* (both from Enabling Technologies) are low-cost, easy-to-use, *Windows*-based programs. You can create complex scenes by combining true 3-D clip art or solid primitives. By learning to use a few icon-based tools, you can change perspectives and camera angles or alter lighting sources.

Though the process was simple, I must admit finding that moving a chair 45 times, in 8 degree increments, to simulate a full 360-degree turn was a laborious task.

After storing all 45 .PCX files on-disk, it was then necessary to translate the images into a format *Animator* could accept. *Animator* runs in the VGA/MCGA mode of 320 by 200 pixels, displays 256 colors on-screen simultaneously (from a possible hardware palette of 262,000), and has adopted CompuServe's Graphics Interchange Format (.GIF) as its native file format.

CompuServe developed and still owns the rights to the .GIF (pronounced "jiff") specification. Designed for the rapid transmission of graphics images via modem, this particular file format is highly compressed, which results in efficient hard disk usage and fast display times. As the .GIF specification has not changed since it first entered the public domain in 1987, it is one of the more stable file formats available.

CONVERTING FORMATS

Zing!, like most graphics programs, exports 16-color .PCX files. And even though a number of other programs (notably the newest batch of paint programs) support the MCGA standard of 320 by 200 and 256 colors, very few of them write the .GIF format directly. (One notable exception to this rule is Mouse Systems' *PC Paint* 3.1.) Fortunately, however, *Animator* has its own conversion utility, which can translate files written in *PC Paintbrush* .PCX, *Deluxe Paint* .LBM, or Targa formats.

Going through the conversion process provides hidden benefits related to the way the program handles the resolution and the color information contained in the incoming file. When importing a 16-color .PCX file with 640 by 480 pixels, the Converter program must read the entire file. Given *Animator*'s own resolution of 320 by 200

Figure 3: The process of creating the illusion of a chair spinning in space begins by creating a number of individual files that show the object from successively different angles.

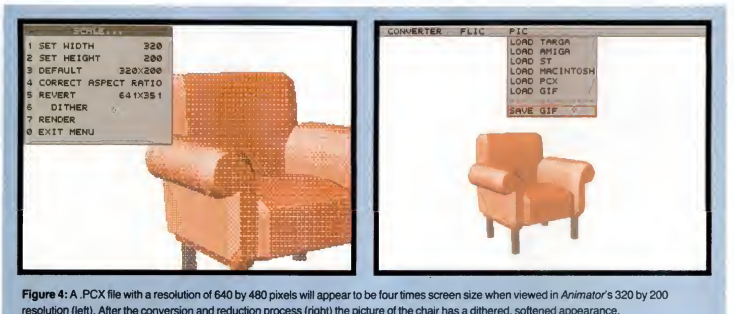

Figure 4: A .PCX file with a resolution of 640 by 480 pixels will appear to be four times screen size when viewed in *Animator*'s 320 by 200 resolution (left). After the conversion and reduction process (right) the picture of the chair has a dithered, softened appearance.

pixels, the image will appear to be four times screen size, as shown in Figure 4. If you choose to clip the image and save only the portion currently displayed on the screen, the conversion program will simply map the 16 colors to a palette, leaving the 240 other colors blank. By capturing a series of clipped screens, moving the file by one or two pixels before each successive capture, you can create a sophisticated panning effect. When this series of .GIF files are linked together, you will see a scrolling background.

As also shown in Figure 4, opting to reduce (as well as convert) the 45 .PCX files produces not only a more appropriately sized chair but creates a softer, dithered effect, as well. *Animator*'s Converter program downsizes an image by replacing two pixels with one and assigning the median color value to the new pixel. In the process, the number of hues in a 16-color painting can quickly rise to 1,000 or 2,000. The Converter program then creates a histogram to determine the most-common colors and remaps the image to the optimum 256-color palette.

At this point, you'd probably like to load up *Animator* straightaway, import the .GIF files into a 45-frame animation sequence (a *flic*), and then watch happily as the upholstery twirls in space. It is more than likely, however, that this short animation of the red chair will suffer from severe flickering, producing flashes of red lightning between each frame. There's a reason for this phenomenon—and a means to eliminate it.

In *Clip 3D* the surface of an object is modeled by a light source. Change the position of an object in relation to the light source and you change the color, be it ever so slightly. Those initial minor color variations are exaggerated in the conversion and reduction processes, so by the time the images are linked together to form a flic, each frame is actually using a unique, conflicting palette. When *Animator* tries to display the 45 images in sequence, your video card must struggle to change from one 256-color palette to the next, flashing the viewer in the process.

Animator's Converter program downsizes an image by replacing two pixels with one.

THE PALETTE MENU

As even this small 45-frame flic demonstrates, it is very easy to surpass the 256-color limitation imposed by 8-bit video displays. Not surprisingly, "true" color video applications rely upon 24- and 32-bit adapters (such as Targa) that can display up to 16.7 million colors.

Happily, *Animator*'s Palette menu contains several commands that can solve the all-too-common problems associated with conflicting palettes. With the troublesome flic loaded, go through the gateway to the Palette menu and invoke the One Palette command. This function will analyze all the colors in every frame of your animation and create a single, shared palette. While it took some time to perform the calculations, after *Animator* thus modified the palette, the chair twirled just as it should.

At this point, however, the animated chair sequence is using every one of the 256 slots in the color matrix. If you want to add bright backgrounds and contrasting type, you'll have to open up a few color slots by using the Squeeze command in the Palette module (see Figure 5). Squeeze remaps colors that are close in value, reducing the total color count in the current frame to a user-specified number.

Unfortunately, however, *Animator* can squeeze only the palette associated with the current frame. To create one lean and mean palette for an entire animation, you should use a neat trick passed along by Autodesk's technical department. Using this technique guarantees that you are fairly representing all of the colors in the entire animation, not just the colors in the current frame.

First, be sure that all of the frames in your flic are using one palette. To do this,

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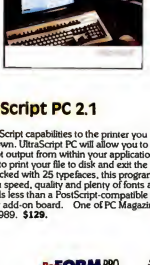

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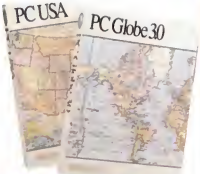

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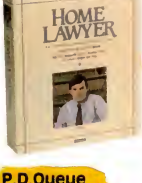

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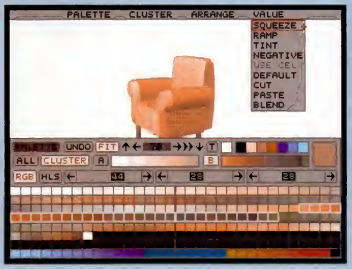

Figure 5: By eliminating unnecessary hues in the palette, the Squeeze command opens up slots in the color matrix. The black slots above can be filled with new colors.

while you're in the Palette menu you should create a giant cluster that contains all 256 colors. Exit out to the main painting screen and add a new frame to the animation. Using the box tool and a horizontal gradient ink, paint a single rectangle measuring 200 pixels deep by 256 pixels wide. When you squeeze this single frame, you are squeezing all of the colors in all of the frames.

To apply this squeezed palette to the entire animation, you must start by saving the new palette to a file. *Animator* can save a multitude of flic-related files, including picture files, animation files, text files, font files, cel files, polygon files, and—as you may have guessed—palette files. When you reload the squeezed palette file over the current animation, *Animator* will ask if you want to Color Fit the screen. Answer yes. The program will then remap each frame of the animation to the new reduced color matrix.

But before you apply the now reduced palette to your flic, you should take a moment to think about the colors you want to use for the text and background. Plan ahead: instead of mixing unrelated colors, it's a good idea to create color ranges that will bridge the gap between background fills and text.

TITLES

Text displayed in *Animator* suffers from the jaggies. Given a resolution of only 320 by 200 pixels, rasterization—most easily discerned in the staircase patterns that occur on the curves of the letterforms—is bound to occur. The easiest way to minimize the problem is to load a blocklike typeface, such as Superbold22, that contains as few curves as possible.

Another method of rounding the letter curves is to employ the (admittedly crude) anti-aliasing tools within the paint program. Anti-aliasing techniques use intermediate colors to trick the eye into seeing smoother curves than are actually there. Both Unzag and Soften inks can produce this effect *if* you have anticipated the need for the in-between colors. Small gradient ranges (background, text, and one intermediate color) work best for text; too many colors make the type look fuzzy.

In our simple word chart example, dark blue text will scroll up the screen and simultaneously fade to the turquoise background color. To accomplish this effect, the palette must contain a subtle gradation of 32 shades of blue.

You start by beginning a new animation, being sure to load the palette you created for the rotating chair sequence and to add an arbitrary number of frames to the flic (I started with 59). Then, from the main *Animator* menu, you go to the Titling panel, which allows you to assign motion to a copy block. The options you need when creating this flic call for the text to scroll up (rather than across), to be centered in the text frame (rather than flush left or flush right), and to move in pixel increments (rather than by character). The Early14 font shown loaded in Figure 6 clearly illustrates severe aliasing on the serifs.

In general, even for small amounts of copy, you will find it more efficient to import the text from a word processor than to type it in directly. Running a spell check on the file can save you from finding an error *after* you have rendered a 100-frame motion effect!

For a perfect example of how the gateways within *Animator* function, click on the Do Titling button. *Animator* saves the information from the Titling panel and shuttles you to another module—the Time Select panel. You should plan to spend a few minutes here, for the layout and icon conventions in the Time Select panel are idiosyncratic. For example, two identical buttons, identified only by the letter *F* in a box, control two different functions. One button applies an animation effect to the current frame only, while the other button fills any shape you create with the currently selected color. You need only learn these eccentricities once, however, because the same panel will pop up whenever

Figure 6: The Early14 font, shown here at twice normal size, shows the effect of aliasing.

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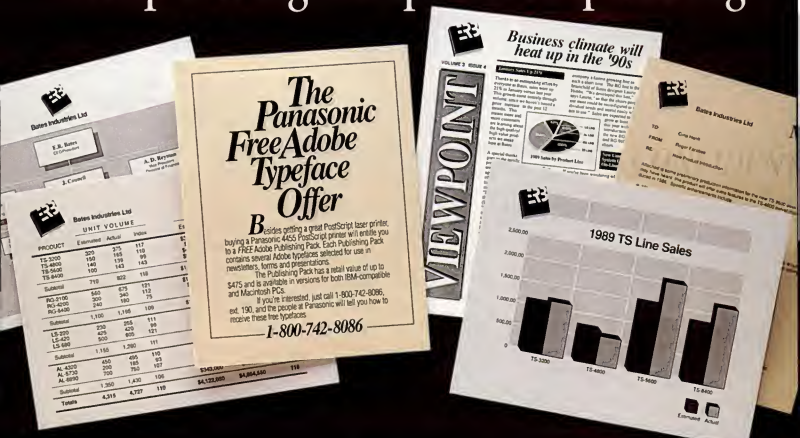

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LPS-PC

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you apply motion to an element, regardless of whether the element in question is a text block, a cel, or an entire animation.

To complete a titling sequence, you must decide whether to apply the effects discussed previously to a single frame, across a section of frames, or to the entire animation. For now, choose the All Frames option. In addition, the Time Select panel gives you control over movement. For example, by choosing Ping Pong, *Animator* will render the titling sequence and then automatically reverse the entire process, creating a ping pong effect. Choosing Reverse will instruct *Animator* to render the movement backwards.

Perhaps the most important function on the Time Select panel is the Preview button. It lets you see the actual result of your instructions without permanently altering the flic. Shuttling back and forth between preview mode, the Time Select panel, the Titling panel, and the text editing frame will become second nature as you learn to make adjustments to the titling parameters—and even to the copy itself—to produce just the right effect.

For example, on the first preview, I found that the dark blue type scrolled up the screen too quickly to read. Slowing down the motion required that you exit back to the Time Select panel and add more frames. The second preview revealed that the text wasn't beginning its scroll at the bottom of the screen. Exiting back to the text editing window, and inserting a few hard carriage returns before the first line of text solved that problem.

The third preview was fine, except that all of the text was opaque. Fading the copy from dark blue to turquoise required exiting all the way back to the Painting functions. You don't have to worry about losing all your work up to this point, because *Animator* will retain the copy and the various motion settings in memory.

Animator actually contains a number of memory buffers. In addition to the text buffer, there is a cel buffer and a screen buffer. The Swap menu gives you access to the screen buffer, which functions as a spare page and can store a picture in memory. If you've been following this discussion with *Animator* running on your machine, you might access the swap page now and use the vertical gradient fill to paint 32 shades of blue on the screen. The dark blue at the bottom of the screen should make a subtle transition to turquoise at the top.

Return to the animation screen and select Scrape as the current ink. As the designation would suggest, scrape "ink" is not a color. It acts like a knife. In effect, it cuts a hole in the top layer of an animation, revealing whatever image is on the spare page below. If you now reenter the Titling panel, click on Do Titling, and preview the flic, the scrape ink will reveal the underlying gradient fill that resides in the screen buffer. If the preview is perfect, click the Render button and wait, while *Animator* paints each frame of the animation.

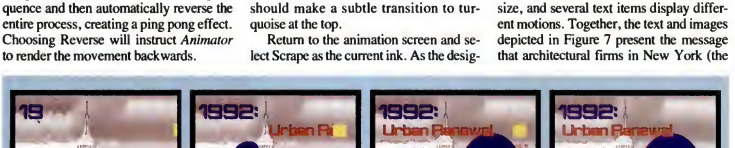

Figure 7: In this second animation illustration, you can see how four different sequences—titles, the spinning pie chart, the pie slice, and the scanned image of the Empire State building—all come together.

COMPOSITE

Animator's flexible toolset usually gives you more than one way to create a special effect. For example, the same fading illusion could have been accomplished with two separate flics and the program's Compositing function. Even for the most basic of flics—like this first animation—compositing is a useful technique. To combine the two segments, first load the chair sequence and choose the background as the key or transparent color. Then, choose to opaque paste the incoming animation (the type) under the current image. Voilà! Blue text scrolls and fades behind a spinning red chair.

Obviously, tools such as Composite and Join become even more important as the animation sequences increase in complexity. And if you discover an error in one portion of the animation, you'll find that fixing it in isolation and then recompositing the flic is the most efficient procedure.

Although the message of the second sample flic is rather simple, scripting the motion involves editing together four individual animation sequences. A scanned photograph of the Empire State Building serves as the background. A pie chart travels across the screen. A pie slice grows in size, and several text items display different motions. Together, the text and images depicted in Figure 7 present the message that architectural firms in New York (the Empire State) will contract more urban renovation projects and less new urban construction in 1992.

This text segment is rather more complex than the titling sequences used in the first animation, though it uses identical techniques. The first flic contained one text frame and the movement was applied to all of the frames. In this second illustrative flic, several text frames vie for the viewer's attention. Some words are typed onto the screen one letter at a time, other words scroll across the screen pixel by pixel. And all of the frames begin their motions at different times. Applying special effects to different segments of the animation creates the impression of alternating intervals and durations.

The background scan, while it builds upon skills learned in the earlier animation sequence, now requires a deeper understanding of the intricacies involved in file importing. Scanned photographic images take advantage of the 256 allowable colors in the VGA/MCGA standard. However, unless you are using an expensive third-

party Service Bureau, you'll find that most scanners—whether simple black-and-white hand-held units or full page desktop models—don't produce the necessary .GIF files.

Aimed at the DTP market, PC-based scanning software tends to concentrate on .IMG, .TIF, and .PCX formats. In some cases, Targa output is an option as well. *Animator*'s own Converter program does not recognize GEM's .IMG format, nor can it import .TIF files. And in 256-color mode, even the .PCX format won't help, because *Animator* can only convert high-resolution 16-color .PCX files. Thus, unless your scanning software is capable of saving 16-, 24-, or 32-bit color Targa files, you'll find yourself having to use an external graphics file conversion program.

If you already own a copy of Electronic Arts' *Deluxe Paint II Enhanced*, however, you can cheat a little. Simply open up a 256-color .PCX file and then save the file in *DP II*'s native .LBM format. *Animator* treats .LBM files as Amiga .IFF files and normally converts them with few problems. I must report, however, that during one particularly knotty sequence of conversions, I found that even though *Deluxe Paint II Enhanced* generated a working .LBM file, *Animator* could not identify the image as a legitimate .IFF file. Explanations about end-of-file markers aside, the nitty gritty solution was to recapture the screen with *Deluxe Paint II Enhanced*'s Camera utility.

For the long run, then, it's a good idea to get a good conversion program, such as Terravision's *The Graphics Link Plus*. *TGL Plus* provides two benefits: it converts .TIF files to .GIF format directly, and it reduces large scanned images to a more acceptable size.

This reduction in size may be more important than you realize. Images scanned at 300 dpi for DTP applications tend to be very large—usually too large for a low-resolution, screen-based application like *Animator*. A little arithmetic will show why. The number of dots (pixels) in a 320 by 200 screen is 64,000. Even when *Animator*'s Converter program successfully reads a high-resolution .PCX file, it still needs to cope with only 640 by 480 pixels, that is, 307,200 dots. By contrast, a 5- by 5-inch image scanned at 300 dpi contains 2,250,000 dots. Even at 200 dpi—when the number drops to only a million dots—*Animator*'s Converter program still runs out of memory.

If your scanner is multibit capable—meaning that it can save images with 16 (4- bit) or 256 (8-bit) colors—you can lower the resolution without any loss in image quality. With 256 colors and 72-dpi resolution the same 5- by 5-inch image will look better on-screen and will contain only 129,600 pixels.

A good rule to follow, if you have access only to a black-and-white (1-bit) scanner, is to aim for an image small enough to fit into memory but large enough to require reduction. Scaling the picture down during the conversion process will introduce shades of gray into the image. Although the process does result in a certain amount of pixelization, you can use *Animator*'s Soften or Unzag inks to minimize the effect.

Animator's Soften or Unzag inks reduce pixelization resulting from conversion.

Before you go on to any other stage in this second illustrative sequence, load the scanned image as a picture. Take a few minutes to Squeeze the palette and to create appropriate colors for the pie chart and text. Remember to save these colors to a palette file and to load the palette each time you create a new portion of the flic.

THE OPTICS MENU

Before starting a complicated animation sequence, it's always a good idea to storyboard the motion involved. Rough sketches with pencil and pad can save you from time-consuming mistakes. Block out the action of the pie chart in this flic. First the pie moves onto the screen by spinning in from the background. Once it has reached its final position, the pie slice begins to grow larger. Even with this informal script, it's now easy to see that the movement requirements can be divided into two logical segments. And as you'll also see, there are sometimes real advantages to rendering the flic out of order, that is, creating the second segment first.

To develop the pie-chart animation, start a new flic, making sure that the palette associated with the scanned image is loaded and that the flic contains 60 frames. To create the pie chart, first draw a filled circle whose area is somewhat larger than you will actually need for the pie chart itself. Using the painting tools, create a small slice in a contrasting color and use the Get Cel command to copy the pie chart to the cel memory buffer. Then clear the picture from the PIC menu.

Go to the Optics menu, from which you can assign complex motions to any one of several objects: cels, polygons, or entire animations. Clear all the previous instructions, and then choose Cel from the Elements menu. From now on all of the parameters in the Optics panel will be applied to the pie chart stored in memory.

The Optics module is a dense collection of commands and functions. A menu along the top of the screen contains various commands, including several preset motions. In addition, it has a panel that lets you indicate the degree of rotation desired and the actual path to be used for movements. *Animator* can move a cel through any combination of *x*-, *y*-, and (simulated) *z*-coordinates.

The pie slice will seem to grow only if the pie itself spins around on a central axis. To move the axis of rotation to the center of the circle, click on Spin and then on Center in the Optics panel. When you then left-click on the drawing screen, you will be presented with a wire-frame representation of your cel. A three-pronged axis will be positioned on the object. Use your mouse to grab and center the axis.

To move the pie chart, click on Spin, then Axis. Notice that the three slider bars in the lower-right corner of the Optics panel now represent the *x*, *y*, and *z* spatial dimensions. You can determine how many degrees the object will rotate (which, in turn, determines how large the pie slice will be) using the Spin/Turns function. The best approach is to move one slider bar at a time. Learn how each slider bar affects the cel's movement by previewing a wire-frame rendition of the animation.

For a more accurate preview of the cel in motion, click on the Use button in the Optics panel. *Animator* will save the current state and shuttle you to the now-familiar Time Select panel. Make sure that the spin will be applied to all of the frames in the animation and click on Preview. Render the flic only if you are satisfied with the preview.

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Lab Notes

At this point in the process, the pie slice moves, but it doesn't grow. Exit the Optics menu (by right-clicking on the painting screen) and invoke the Opaque Trails option from the Special Effects list on the Flic menu. Trails will paste each previous frame of an animation into the current frame, creating the illusion that the pie slice is getting bigger over time.

The curves and diagonal lines in the pie chart will display noticeable aliasing. By now, however, the jaggies and the methods employed to reduce them are already familiar to you. Just think back to the way text was introduced in the first animation series.

To get rid of the sloppy edges along the outside of the circle, create an overlay that consists of a "smooth" circle—as smooth as circles get in *Animator*. Join it to the pie slice either by compositing it over the flic or by using the swap page and scrape ink. You can further reduce the jaggies by applying Unzag, or Soften inks to the pie.

CUMULATIVE MOTION

You'll find that it is often easier to plan a complicated move if you work backward from the end position. That's why I suggested earlier that you plan to film the two pie chart segments out of order. Start by clipping a cel that contains the pie chart as it appears in the first frame of the current flic. Now begin a new animation with at least 60 frames. The cel buffer will still contain the pie chart in the right position even though the animation is new.

Next, call up the Optics menu, shown in Figure 8. Clear the previous settings and make sure that the movements will be applied to the cel. Since the settings in the Optics panel are cumulative, you can determine the spin of an object, preview the wire frame, add a pathing function, preview the wire frame, and then add a sizing function.

That is precisely the way you will assign motion to the pie chart in this flic. You want the chart to move along a splined curve, spin around the *x*, *y*, and *z* axis, and simultaneously get smaller in size. When you preview these motions with the wireframe representation, the frame will start out in the end position and move off the screen. However, once you enter the Time Select panel, you can choose to render the motion backward. Then, when you preview the flic, the cel will start out as a tiny pie in the corner of the screen. It will twirl and spin its way closer to the viewer along the predefined path and will ultimately come to rest in exactly the location where the pie chart exists in the other animated sequence.

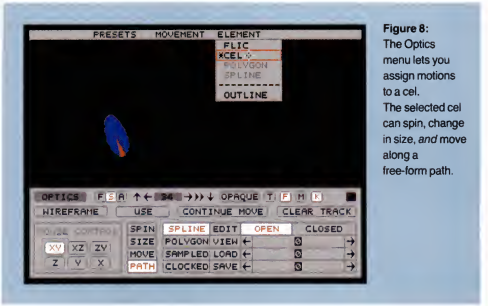

Figure 8: The Optics menu lets you assign motions to a cel. The selected cel can spin, change in size, *and* move along a free-form path.

When you then Join (on the Flic menu) the first segment to the second, the pie chart will align perfectly. At this point you can use Composite on the flics in any of several ways. You can opt to load the scan of the Empire State Building to the swap page and then fill the background of the pie-chart animation with Scrape ink. Or you can overlay two separate flics using the Composite function. Either way, bear in mind that maintaining each section of the animation as a separate flic takes up a considerable amount of disk space. Up to a quarter of a megabyte may be necessary for each 230-frame section. However, if you discover (as I did) that on your first attempt, the text becomes illegible when it's pasted on top of the scanned image, you'll be grateful that you saved everything in the form of separate files.

MACROS

One of my favorite cookbooks absolutely refuses to list amounts for ingredients such as salt, because, as the author explains, the idea is to teach you how to cook, not how to follow a recipe. In the same way, I've avoided giving you the exact number of frames to use for text scrolls, or the exact degree of rotation to use on the pie chart. Simply reproducing this demo is not an end in itself. The point is rather to learn to use computerized animation techniques so that you can apply these skills to your own business presentations.

Probably the most important skill you should have learned so far is to use the visual feedback of the Preview function to determine what looks right. *Animator*'s real strength is in its interactive approach to creating movies. If the preview doesn't please you, simply change the motion settings or alter the colors.

You've learned how to convert and import images into *Animator*, and you've gained experience with sophisticated Palette manipulations, as well as complex Titling, and Optics maneuvers.

When all is said and done, however, this tutorial can't teach you how to orchestrate movement so that it clarifies, rather than obscures, the content of your message. Certainly the animations presented here are hardly paradigms of content. But take a moment to consider the hierarchy of movements in the pie-chart animation. The dateline is typed onto the screen while the actual pie spins across the skyline. Though the effect is fun, the viewer can register the movement with peripheral vision in order to concentrate on the text. In the same way, the main message scrolls onto the screen in sync with the expanding pie slice.

In the most traditional sense, you are the director of your movie—the Steven Spielberg of the business set, as it were. Learning how to coordinate motion in order to emphasize the important part of your message ultimately makes your argument more businesslike, because it's more convincing. ■

Luisa Simone is a contributing editor of PC Magazine.

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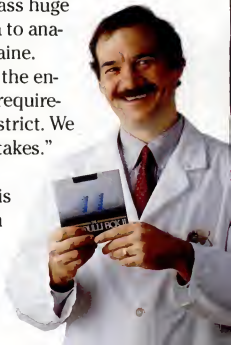

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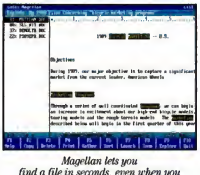

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by
Michael J. Mefford

Utilities

For Your Eyes Only: Keeping Files Private in a PC-based Office

■ Password protection and screen blanking combine in CONCEAL to give your files just the degree of protection appropriate to the office environment.

You probably have at least one file on your disk that you don't want anyone else to see. It may be anything from private correspondence to payroll data. But in an office full of PCs, there will inevitably be times when that file could be read or modified by the wrong people.

You may, for example, have to step away from your desk on a short errand that turns unexpectedly into a lengthy ad hoc hall conference, leaving your machine accessible to an office snoop in the interim. Or you may be working on a sensitive document when the local gossip walks in and it would be rude to say, "Please freeze right there while I save this document and exit this application."

The answer to these needs is CONCEAL.COM. It gives you just enough security so that no one can simply rummage through your files while you're away from your computer, and it provides a way to hide a document instantly without your making a federal case out of it.

CONCEAL.COM is the combination of a low-level software file-security utility and a screen blanker. The file security portion allows you to lock one or more files so that they subsequently require a password in order for anyone to gain access. The other portion of CONCEAL lets you blank the screen either immediately with a hotkey or after a specified time-out of keyboard inactivity. You can use both parts of the program together or separately, and a host of options let you customize CONCEAL to your needs.

You can download a ready-to-run copy of CONCEAL.COM from PC MagNet by following the instructions given in the sidebar "CONCEAL by Modem." Alternatively, you can download CONCEAL.BAS from PC MagNet and run it once in BASIC to create the CONCEAL.COM file. There is also a third option to consider; you may want to modify or assemble the program yourself. In this case you should download CONCEAL.ASM. Once you have the code, you must use an IBM or Microsoft macro assembler, Version 2 or later, and the following commands:

```
MASM CONCEAL;
LINK CONCEAL;
EXE2BIN CONCEAL CONCEAL.COM
```

The overall command syntax for CONCEAL.COM is

```
CONCEAL [/P password] [filespec]
 [options]
```

In short form, the complete list of *options* is shown on the DOS manual page printed as a sidebar to this article. Entering CONCEAL without any parameters will produce the same options list on-screen. Note that most of the option switches have ON and OFF states. If you enter an option without an ON or OFF argument, the default will be ON. A fuller discussion of each option is given below.

FILE SECURITY OPTIONS

When you enter

```
CONCEAL filespec /S
```

you add the System attribute to all the files that match the *filespec*. Normally, the System attribute is used only by the boot system files, IBMBIO.COM and IBMDOS.COM. Most applications—including the DOS DIR command—cannot find a file that has been given the System attribute, so adding that attribute itself usually provides enough security to protect your files from the prying eyes in your office. There are *some* applications, however, that can "see past" the System attribute. Therefore, in order to monitor—and prevent—any attempts to remove the System attribute *and* any DOS calls to open, delete, and rename files that have a System attribute, the /S option also loads CONCEAL.COM as a TSR (terminate-and-stay-resident) utility. When installed as a TSR, CONCEAL requires 1K of RAM.

To regain access to a CONCEALed file, you enter

```
CONCEAL /P SHAZAM filespec /S OFF
```

This removes the System attribute from the *filespec*. SHAZAM is the default password; see the /N option below to learn how to change the password.

It's definitely a good idea to list CONCEAL.COM as a line in your AUTOEXEC.BAT file. This way, if you don't come to work one day and someone happens to turn on your system, CONCEAL will still be installed automatically. You don't have to include the *filespec* every time CONCEAL is installed to protect your sensitive files, however. The System attribute becomes part of the files' directory record and will stay there even when you turn the system off and on.

To illustrate, suppose you have a file called SECRETE. To protect it initially, you might enter

```
CONCEAL SECRETE /S
```

This will attach the System attribute to SECRETE. Putting the line

```
CONCEAL /S
```

into your AUTOEXEC.BAT will install CONCEAL each time you boot up. Since SECRETE already has the System attribute, no one will be able to access it. Using this approach, anyone who peeks at your AUTOEXEC.BAT won't have a clue as to *which* file you are protecting.

Of course, the super snoop could temporarily delete CONCEAL.COM in your AUTOEXEC.BAT and reboot your system, but even if that happened the System attribute would make it hard to find the SECRETE file; the DOS DIR command will fail to list it.

Remember, however, that if you enter

```
CONCEAL /P SHAZAM SECRETE /S OFF
```

so that you can access SECRETE yourself, you must again enter

```
CONCEAL SECRETE /S
```

when you are through with the file, to ensure that the System attribute will be reattached to it.

Remember, too, that you must *never* CONCEAL CONCEAL.COM! If you do, DOS won't be able to find CONCEAL. This means that you won't be able to run CONCEAL, and that in turn means that you won't be able to *unconceal* either CONCEAL.COM or any other files you have CONCEALed.

Turning the System attribute on and off can be a nuisance if you often have to access a sensitive file. You can use the /F option to access files without removing the System attribute. Entering

```
CONCEAL /P SHAZAM /F OFF
```

will turn off the file security monitor in the TSR portion of CONCEAL. Note, however, that you *might* not be able to access a protected file in this manner; the presence of the System attribute may confuse your application. In such a case you'll have to turn OFF the System attribute with the /S option.

You can also change the other file attributes—Archive, Hidden, and Read-Only—with the optional /A switch parameter. Charles Petzold's ATTR.COM

THE BOUNCING BALL

by Michael J. Mefford

Bouncing a ball around the screen during graphics blanking proved to be an interesting and enjoyable programming challenge. The technique I selected was to write a 4 by 8-byte rectangle containing the bit image of the ball directly to video memory. This is much easier than masking and writing the individual pixels of the ball itself.

The ball image is surrounded on all sides by at least one pixel that is the same color as the background. Since the ball is never moved more than one pixel in either axis, these surrounding background pixels ensure that the old ball position is erased automatically with each move.

The best way to picture how this works is to use a picture. You can follow along in Figure A as I describe the motion of the ball as it moves diagonally from the upper-left corner of the screen towards the lower-right corner.

Before starting, however, I should note that the CGA graphics mode 4 used for the bouncing ball display is 320 pixels wide by 200 pixels tall. I picked video mode 4 because it works on all color adapters. For this purpose there's no point in making the modifications needed for the high-resolution EGA and VGA displays. Four colors are possible with the 2 bits that represent a pixel in CGA graphics video mode 4—00, 01, 10, and 11. 00 is the background color, which is usually black. I've used 01 for the ball that, under the palette I've chosen, is cyan. Since there are 8 bits per byte, that means there are 4 pixels per byte.

During CONCEAL's screen-blanking mode, variation of movement is affected by adding a little "spin" to the bouncing ball's slope each time it hits the display boundaries.

CONCEAL's ball image is contained in 8 rows of 4 bytes represented by the pairs of 01 (cyan) pixel bits shown in the multiframe diagram of Figure A. In Frame 1 the ball is poised to start its journey from the top-left corner of the screen—the first address of video memory.

As the ball is moved diagonally down to the right, the bits of the image are shifted two positions to the right with each move. This achieves the rightward part of the movement without changing the column byte address. The video address for the write is also moved down one row with each write, producing a smooth 1:1 slope.

For the second write, the image is written in the same column but one row lower, as shown in Frame 2. The next two frames follow the same principle, with each move being created by shifting one pixel to the right and dropping one row. The column byte address for the write remains unchanged. Let's skip the third frame and go to the fourth.

In Frame 4 you can see that the ball has now shifted 3 pixels (6 bits) to the right and moved down 3 rows. The next move to the right will make the total shift 8 bits—one full byte—from the starting position. This involves moving CONCEAL's copy of the image back

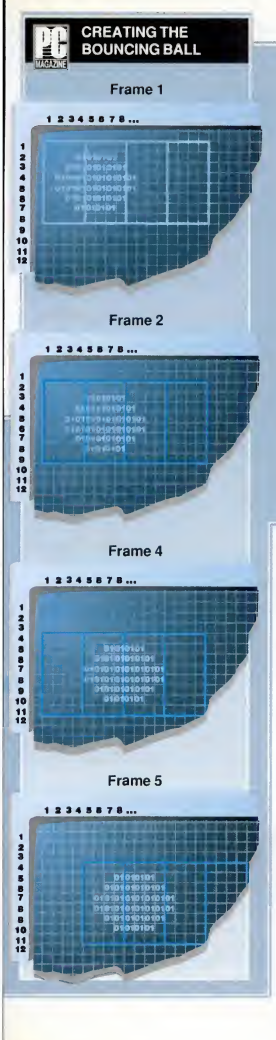

Figure A: These frames show the successive positions of the pixels that form the bouncing ball display of the CONCEAL /G option. While the motion shown here is linear, a "spin" imparted when the ball strikes a side of the screen ensures that the same path is not retraced continuously.

to the left 4 pixels (8 bits) to its original position and then writing the image in the next column byte address to the right.

The result, shown in Frame 5, is that the ball appears to move smoothly across the screen, one pixel at a time. The next move to the right looks like Frame 2 except now the column byte address is one to the right. Every fourth frame the image is reset and the column shifts one to the right.

The slope of the ball begins at 1:1. A little "spin" is added to the slope each time the ball hits the screen boundaries, however, to add some variation to the movement. Specifically, the slope is tracked with Bresenham's line-drawing algorithm. If you're interested in the details of the algorithm, download the source code from PC MagNet. ■

utility of a few years back is designed to let you change any of a file's attributes, and the /A option incorporates the same functions of ATTR into CONCEAL. The syntax for this option is

```
CONCEAL filespec /A [+|-A] [+|-S]
 [+|-H] [+|-R]
```

Using a plus sign adds an attribute and using a minus sign removes it. The four attributes are Archive, System (which the /S uses), Hidden, and Read-Only. Note that if CONCEAL is installed and active, you must type in your password in order to remove or add an attribute using the /A switch. This ensures that a snooper can't gain access by removing the System attribute.

Naturally, since the default has been published here, one of the first things you'll probably want to do is change the password. To do so, enter

```
CONCEAL /P SHAZAM /N new password
```

A shorter password might be in order if you don't like to type, but don't make the password obvious, as by using your initials, for example. CONCEAL will ask if you want to make the new password permanent. If you press Y, the new password will be written into CONCEAL.COM. CONCEAL has to find itself in order to make the change, so it must either be in your current default directory or its directory must be one included in your DOS PATH= command. Incidentally, CONCEAL.COM encrypts your new password, so someone can't look for it with a file-viewing utility, such as DR.COM. If you answer N at the prompt, the new password you have entered will remain in effect only until you reboot the system or change it again. One caveat: do *not* use a password that contains control characters (characters with ASCII numbers below 32, the ASCII space) or high-order ASCII characters (those with numbers above 127).

SCREEN-BLANKING OPTIONS

Entering

```
CONCEAL /B nn
```

will install CONCEAL as a hardware screen blanker with a time-out of *nn* minutes. The time-out period can range from 0 to 60 minutes; the default is 3 minutes. If no keyboard activity is detected in *nn* minutes, the screen goes blank, which has the additional advantage of protecting the screen phosphors against possible "burn-in" by a stationary pattern. Once installed, resetting the *nn* value to 0 minutes turns off screen blanking. You can restore the display, once blanked, by pressing any key. CONCEAL itself does not pass the keystroke to the underlying program, however, so you don't have to worry about it being passed through to your current application.

The hardware screen-blanking technique used here involves disabling the video signal by turning off one of the bits of the video port. Specifically, it's bit 3 of port 3D8 on the color adapter and port 3B8 on the monochrome adapter.

Screen blankers of this type have been around for a long time. I have heard it *said*, however, that hardware blanking could damage some Hercules video adapters. On the other hand, I have never heard of any actual case in which a Hercules adapter *was* damaged by a screen blanker. But since I can't prove a universal negative, the most I can say is that if you have a Hercules adapter, use CONCEAL's blanking feature at your own risk. It's known to be

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THE PROGRAMMING CHALLENGE

by Michael J. Mefford

I initially took a completely different approach to file security from the System attribute implementation finally adopted in CONCEAL.COM. My first thought was to change the disk directory entries for the files to be secured in such a way that DOS would not recognize them. I knew that DOS expected all entries in the disk directory to be stored in all-capital letters, no matter which case you used when typing them. So it seemed that one logical technique would be to change the protected directory entries to lowercase. Filenames with all numbers would have to be treated differently, but I thought I could solve that.

It's not easy, however, to create or change a filename to lowercase. Try it for yourself. Enter the following at the DOS prompt:

```
COPY CON test
asdf
<F6>
<Enter>
```

These commands COPY what you type at the CONsole (keyboard) to a file called `test`. Be sure to enter the word "test" in lowercase. The next line is gibberish that makes sure there is *something* in the file. Pressing F6 sends a terminating Ctrl-Z to the file, and pressing Enter closes the new file. You've just created a file called `test`.

Now enter

```
DIR test
```

At this point, DOS will list the new file something like this

```
TEST          4   8-12-90   8:34am
```

Note that the name of the file is now in uppercase, despite our effort to create and list it in lowercase. DOS automatically capitalizes filenames to make directory searches easier and faster.

File security is effected by changing the file attribute to a system attribute.

The only way a filename can be changed into lowercase is by making direct sector writes (DOS interrupt 26h) to the directory sector. That takes a bit more work, because you have to figure out the location on-disk for the directory sectors, but it can be done.

I changed a TEST filename on a floppy directory to lowercase with the aid of DEBUG's direct sector write commands and then asked DOS for a

```
DIR test
```

again. As I had suspected, DOS could no longer find the file. DOS capitalizes the "test" you type at the DOS prompt and then looks for a match on-disk expecting all entries to be in uppercase. Result, no match.

But what on the surface looked like a slick way to achieve file security had one serious flaw. I created a new file called TEST in the same directory as `test`, issuing the same COPY CON commands used above. DOS obliged, doing so without writing over lowercase `test` file. I then changed the `test` filename in the disk directory back to uppercase so that I could recover it.

So far, so good. A DOS DIR command, however, now listed two TEST files. That was confusing, although correct. A user might very well also be confused, however, and try to delete *one* of the TEST files. I went through the motions and entered

```
DEL TEST
```

DOS deleted *both* TEST files. It's as if I had entered DEL TEST*.*.

Worse still, I found that if a directory filename is changed into lowercase and you then run CHKDSK, CHKDSK gets confused and wants to recover what appear to be lost cluster chains. In both cases, the result is lost data.

So I settled on the second, safer avenue toward file security, that of changing the file attribute to a System attribute. The System attribute normally is used with the system files IBMBIO.COM and IBMDOS.COM. (For MS-DOS, those system files will be IO.SYS and MSDOS.SYS.) As far as I know, no other files use the System attribute, and the technique seems to work well. However, there *may* be a few applications that take advantage of the System attribute; if so, CONCEAL will cause conflict. ■

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The /G option requires an additional 5K of RAM (1K of code and 4K for screen data) to save the screen contents so that they can be restored when you touch a key. I call it graphics blanking, because the screen is switched from text to graphics video mode 4. However, it works only if you are in a text mode when it comes time to blank the screen.

If /G is selected and a graphics mode is detected when it comes time to blank the screen, the screen will be hardware blanked; it will just go completely black. When you later change to text mode, the graphics blanking option you selected will be resumed. If you have a monochrome or Hercules adapter and enter the /G parame-

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To download CONCEAL.COM and its assembly or BASIC listings, log on to PC MagNet. Enter GO UTILITIES or choose PC MAGAZINE UTILITIES from the top menu, then DIRECT UTILITY DOWNLOAD from the next menu. Enter the filename, then select the file you want to download from those presented. Answer yes (Y) to DO YOU WISH TO DOWNLOAD? Press Enter to see the transfer protocols. Choose a protocol and download the file.

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CONCEAL Command

Michael J. Mefford — September 11, 1990 (Utilities)

Purpose: Provides file security through password protection of selected files and a screen-blanking system activated either by a hotkey or by a period of keyboard inactivity. Most *options* explained below have ON and OFF states (default on) that may be entered with the parameters.

Format: `CONCEAL [/P password] [filespec] [options]`

Remarks: CONCEAL.COM is normally loaded as a TSR (requiring approximately 1K of RAM) via the AUTOEXEC.BAT line

```
CONCEAL /S
```

Files are then protected with the command

```
CONCEAL filespec /S
```

This applies the DOS System attribute to the *filespec*, making it invisible to DOS. CONCEAL then monitors and fails any attempts to remove the System attribute and any DOS calls to open, delete, rename, or change the file attribute of protected files unless the proper password is supplied. Legitimate access is provided by the command

```
CONCEAL /P password filespec /S OFF
```

This turns off the *filespec* System attribute, which must later be reapplied. (The /F option allows password-access without removing the System attribute, but may not work with all applications.) The default *password* SHAZAM can be changed with the /N parameter option. Other file attributes (Archive, System, Hidden, Read-Only) can be changed with the /A option:

```
CONCEAL /A filespec [+|-A] [+|-S] [+|-H]
 [+|-R]
```

Hardware screen blanking is provided by entering

```
CONCEAL /B nn
```

where *nn* is a number of minutes from 0 to 60. The default is 3 minutes, and a value of 0 for *nn* turns blanking off. The /G option may be entered instead of /B to provide a bouncing ball instead of a blank screen display. Instant blanking is achieved with a hotkey (default Alt-Z), which may be changed to any Alt- or Ctrl-alphanumeric key with the /H option. From graphics mode, the /G option defaults to /B. To blank over graphics applications such as *Microsoft Windows*, use the /O parameter. Adding the /T switch will require password entry rather than a simple keystroke to terminate screen blanking. The /U switch uninstalls CONCEAL.

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ter, CONCEAL will automatically use the /B hardware blanking.

CONCEAL detects keystrokes by monitoring interrupt 9, the keyboard interrupt. Some applications steal interrupt 9 and refuse to share it with any other background application like CONCEAL. (Old versions of *XyWrite* are an example of this; recent versions work just fine.) If the screen goes blank and the tap of a key fails to revive it, you know that the application you are using falls into this category. If this happens, think of the steps needed to exit the program and try to execute them while "flying blind." Then disable blanking and try the application again.

You may also want to suspend blanking temporarily when using applications that get most of their input from a mouse. CONCEAL won't respond to squeaks, so you'll have to leave the mouse and tap a key whenever the time-out expires.

The best way to suspend the blanking option is from a batch file consisting of the commands

```
CONCEAL /B OFF
application_name
CONCEAL /B ON
```

Insert the appropriate start-up command for *application_name*, and substitute /G for /B if you are using graphics blanking.

When /G Graphics takes effect, CONCEAL retains control so that it can bounce the ball around. This means any application that is active will be frozen until you touch a key; /G will not permit anything to continue. This includes printing, a spreadsheet recalculation, database sorting, program compiling, and communications. Either switch to /B hardware blanking or turn OFF blanking if you wish for any of these background tasks to continue while the screen is blanked.

You can use the /O switch if you don't want CONCEAL to blank Over graphics applications. Use this option if you use *Microsoft Windows*. *Windows* is one of those applications that takes over the keyboard interrupt. Further, since many graphics applications are mouse driven, the /O option is advisable if you use that type of software.

Normally, when the screen-blanking option is active, any touch of a key will restore the display. This may not provide enough security. By adding the /T parameter, however, you add the requirement that the password be entered before the screen can be reactivated. You can then safely leave the office with a sensitive document on the screen. When the screen blanks, no one can slip in and touch a key to see what you were up to. When you return, you'll have to type in your password blindly, since the screen will be blanked. And remember to press Enter after doing so. If you make a mistake, just clear the entry by pressing Enter and start again.

By using the /H option you can immediately blank the screen with a designated hotkey. The default hotkey is Alt-Z. The hotkey lets you hide your work quickly when someone walks in inconveniently. You may also may want to blank the screen with the hotkey before you leave your desk. Again, if the /T is also ON, password entry will be needed to reenable the screen.

CONCEAL's /T parameter keeps your files under top security: it requires a password to reactivate files that have been hidden by screen blanking.

The same /H option that activates hotkey blanking lets you change the designated hotkey. If the default Alt-Z conflicts with another TSR or application macro, you can substitute any other Alt- or Ctrl-alphanumeric key combination. To change the hotkey to Ctrl-Q, for example, you would enter

```
CONCEAL /H CTRL Q
```

To change the hotkey permanently, you should include this switch in the line in your AUTOEXEC file.

CONCEAL is installed as a TSR when any one of the /S, /B, or /G switches is selected. You can use

```
CONCEAL /U
```

to uninstall the utility, subject to the usual limitation that no additional TSR has been installed after it.

As with any security provision—especially when it's software—the craftiest of snoops can defeat it. I thought about using a tougher system, but it created more problems than the added security warranted. The sidebar "The Programming Challenge" details the kinds of difficulties encountered. Still, I think you'll agree that CONCEAL gives you all the security you really need in the average office. ■

Michael J. Mefford is a contributing editor of PC Magazine.

PC UTILITIES UPDATES

Like all good software, the programs presented in *PC Magazine* are upgraded and improved. The only way to obtain the modified versions is to download them from PC MagNet. Here is a partial list of the programs that have been upgraded to fix minor bugs and system incompatibilities:

ANSI.COM, Version 1.3
BEN55.ARC (PC Labs Benchmark Series, Release 5.5)
CARDFILE.COM, Version 1.1
CHKFRAG.EXE, Version 1.2
DIRMATCH.COM, Version 1.1
EMS40.SYS, Version 1.1
LITES.COM, Version 1.1
LOG.COM, Version 1.1
PCMANAGE.EXE, Version 1.1
RN.COM, Version 2.0
SLICE.COM, Version 1.3
SNIPPER.COM, Version 1.2
TPFST-AT.COM, Version 1.1
ZCOPY.COM, Version 1.2

For a complete list of all the programs available from the PC MagNet Utilities Database, download UDCAT .ARC.

A downloadable index to *PC Magazine*'s product reviews is also available. PCM.EXE is a self-extracting file that contains the *Computer Library PC Magazine* Reviews Index for January 1988 to December 1989. It requires the search files in PCSRCH.EXE. Please read the information file PCM.INF before you download any of these files. ■

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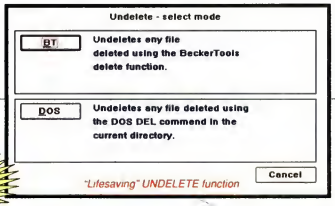

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BITMAP FORMAT INTRODUCED IN OS/2 1.1

```
typedef struct _BITMAPFILEHEADER // standard prefix is 'bfh'
  {
  USHORT          usType ;      // set to 'BM' for bitmaps
  ULONG           cbSize ;      // size of the file in bytes
  SHORT           xHotspot ;    // set to 0 for bitmaps
  SHORT           yHotspot ;    // set to 0 for bitmaps
  ULONG           offBits ;     // offset of bitmap data from top of file
  BITMAPINFOHEADER bmp ;        // another structure
  }
  BITMAPFILEHEADER ;


typedef struct _BITMAPINFOHEADER // standard prefix is 'bmp'
  {
  ULONG  cbFix ;                // size of information header (12)
  USHORT cx ;                   // width of bitmap in pixels
  USHORT cy ;                   // height of bitmap in pixels
  USHORT cPlanes ;              // set to 1
  USHORT cBitCount ;            // number of color bits per pixel
  }
  BITMAPINFOHEADER ;


typedef struct _BITMAPINFO      // standard prefix is 'bmi'
  {
  ULONG  cbFix;                 // size of information header
  USHORT cx;                    // width of bitmap in pixels
  USHORT cy;                    // height of bitmap in pixels
  USHORT cPlanes;               // set to 1
  USHORT cBitCount;             // number of color bits per pixel
  RGB    argbColor[1];          // array of RGB structures
  }
  BITMAPINFO ;


typedef struct _RGB             // standard prefix is 'rgb'
  {
  BYTE bBlue ;                  // blue value
  BYTE bGreen ;                 // green value
  BYTE bRed ;                   // red value
  }
  RGB ;
```

Figure 2: The bitmap structures defined in the OS/2 1.1 header files.

tograph, for instance, requires a bitmap. A metafile (unless the metafile can store bitmaps) just doesn't work. Also, as we've seen in earlier columns, bitmaps can often be drawn much faster than complex vector graphics.

COMMON BITMAP FORMATS

Over the years, several bitmap formats have become popular for the interchange of graphics images on personal computers.

ZSoft invented the .PCX format for its *PC Paintbrush* products. The format has gone through several revisions and is now a bit awkward. (For example, the header of the .PCX file has room for a color table that includes only 16 colors. You have to append the color table to the end of the file for a 256-color .PCX file.) Regardless, the .PCX file is quite popular. Here at *PC Magazine*, we use .PCX files for our screen shots.

The .PCX file uses a run-length encoded (RLE) algorithm to compress the bitmap data. It's very common in a bitmap image to have pixels of the same color appearing consecutively. This is called a *run*. Rather than repeating the same bits over and over, a run-length encoding algorithm allows this data to be compressed in a very simple way by having a repetition factor to indicate how many times the color is to be repeated.

If you frequent CompuServe, you may be familiar with the .GIF (Graphics Interchange Format—pronounced "jiff"). CompuServe developed this format for storing graphics files that you can download. Various .GIF viewers are available to let you look at these files. Like the .PCX format, the .GIF format is limited to 256 colors. Because CompuServe disk space is not unlimited, .GIF files use a more-sophisticated compression technique than RLE—a variation of the Lempel-Ziv-Welch (LZW) algorithm.

Probably the most flexible bitmap file format is TIFF (the Tagged Image File Format). This format was designed by Aldus, Microsoft, and Hewlett-Packard. The format is so flexible it can even accommodate different byte orderings on the Intel and Motorola microprocessors. Indeed, the TIFF format has so many options that routines to read TIFF files can be quite complex. Another problem with TIFF is that the color model is a little awkward for current video displays.

Adobe Systems contributed Encapsulated PostScript (EPS), which is a form of PostScript that can be embedded into a document. PostScript, of course, is more like an intelligent metafile than a bitmap format, but it includes an operator called *image* that allows bitmaps to be rendered. Many EPS files contain only a bitmap and some PostScript code to render it.

And, of course, both *Windows* and the OS/2 Presentation Manager have their own bitmap formats. A *Windows* or PM bitmap can be stored in memory or on-disk with a filename extension of .BMP.

THE OLD WINDOWS BITMAP FORMAT

Let's begin with what is perhaps the worst bitmap file format ever devised—the one defined in *Windows* 1.0 and the only *Windows* bitmap format until *Windows* 3.0 was released. I'll refer to this as the "old" *Windows* bitmap format.

Figure 1 shows the layout of the old *Windows* bitmap file. Although this format is now considered obsolete, I'll describe it a little, because some of the concepts are important to the later bitmap formats.

There are basically two sections in this file: 16 bytes of header information, followed by the data that makes up the bitmapped image. The bitmap bits are stored beginning with the top row of pixels of the image. (A row of pixels in a bitmap is sometimes called a *scan line*.) The bytes in each row are ordered so that the leftmost pixels start with the most significant bits of the first byte.

Two fields indicate the height and width of the bitmap in pixels. Two additional fields describe how color is encoded in the bitmap. For a monochrome bitmap, the number of color planes and the number of color bits per pixel are both set to 1. For a color bitmap, one of these fields is greater than 1. Which of the two fields is greater than 1 depends on the internal organization of memory on the output device.

For example, for a 256-color bitmap compatible with the IBM 8514/A video adapter, the number of color planes is 1 and the number of color bits per pixel is 8. Each byte of bitmap data corresponds to one pixel.

by
Charles Petzold

Environments

What's New in Bitmap Formats: A look at Windows and OS/2

As I mentioned in the previous installment of Environments, OS/2 2.0 has a new bitmap format. This is an extension of the new bitmap format in *Microsoft Windows* 3.0 (called the *device-independent bitmap*, to distinguish it from the earlier *Windows* bitmap format), which in turn is an extension of the bitmap format in OS/2 1.1.

Yikes! In one paragraph I've just mentioned four bitmap formats in several versions of two operating environments from the same company. It would have been nice, of course, if Microsoft had simply designed a single bitmap format way back when and used it for everything. But you've probably learned by now not to expect this type of consistency.

Fortunately, the developers of PM and *Windows* seem to have been talking to each other: three of these four bitmap formats are quite similar and can be handled in *Windows* and PM applications without an extensive amount of extra code. (The exception is the original *Windows* bitmap.) This is what I'd like to discuss and demonstrate in this column and a future installment.

■ Finally *Windows* and OS/2 bitmap formats are similar enough to be handled in *Windows* and PM applications without much extra coding.

STORING GRAPHICAL DATA

A *bitmap* is one of two common ways to store graphical data. It is a rectangular array of bits in which 1 or more bits correspond to the pixels of a graphics image. In a monochrome bitmap (capable of storing an image with two colors, usually black and white) each bit corresponds to a single pixel. A bitmap for a 16-color image requires 4 bits per pixel and a 256-color bitmap requires 8 bits per pixel.

The other standard method for storing graphical data is the *metafile*. A metafile is a collection of drawing commands encoded in a binary form. The drawing commands usually correspond quite closely to the drawing functions in the underlying graphics programming language. For example, a straight line can be stored in a metafile by a code that indicates a line and numbers that indicate the beginning and ending coordinates of the line.

Both the *Windows* Graphics Device Interface (GDI) and the OS/2 Graphics Programming Interface (GPI) support both bitmaps and metafiles. Bitmaps and metafiles can exist in memory or be stored on the disk as files.

There are advantages and disadvantages to both formats. Bitmaps are more closely linked to particular output devices, both in terms of resolution and color. While metafiles can often be scaled to a particular size without loss of information, expanding or compressing a bitmap can be a problem. Expanding a bitmap requires rows or pixels to be duplicated, sometimes imparting graininess or a moiré pattern to the image. Compressing a bitmap can result in loss of information. And some graphics output devices (like pen plotters) cannot draw bitmaps.

In addition, bitmaps can be quite large. For example, representing an 8514/A screen requires 768K of bitmap data. For this reason, various compression algorithms are often used to reduce the amount of space a bitmap file needs. Metafiles, by contrast, are usually much smaller.

But there are many images that simply can't be represented by lines, areas, and text stored in a metafile—a digitized pho-

THE OLD *WINDOWS* BITMAP FORMAT

Offset	Size	Description
0	1	Set to 2
1	1	Set to 0x80 for discardable bitmaps, 0 otherwise
2	2	Set to 0
4	2	Width of bitmap in pixels
6	2	Height of bitmap in pixels
8	2	Width of bitmap in even number of bytes
10	1	Number of color planes
11	1	Number of color bits per pixel
12	2	Set to 0
14	2	Set to 0
16	N/A	The bitmap bits

Figure 1: This is the first *Windows* bitmap file format, used in all versions prior to *Windows* 3.0. While this format is now considered obsolete, some of the concepts are important to later bitmap formats.

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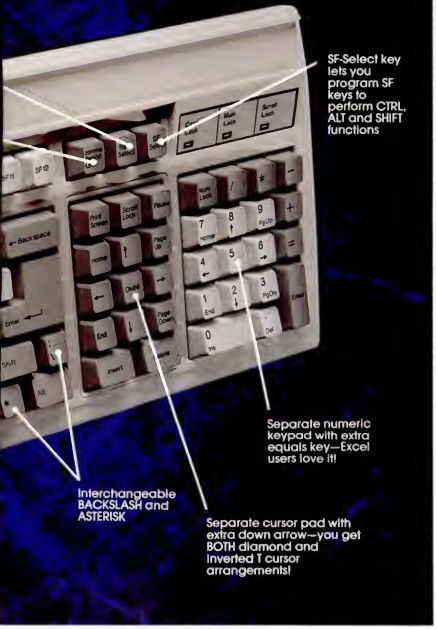

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Before *Windows* 3.0, *Windows* used only eight colors when running on the EGA and VGA. The memory of these video adapters is organized into color planes and the bitmap corresponds to that. The number of color planes is set to 3. The bitmap data begins with the rows of the red plane (1 bit corresponding to each pixel), then the green plane (again, 1 bit for each pixel), followed by the blue plane. Thus, each pixel is defined by a total of 3 bits.

Note that there is a field with the width of the bitmap in bytes. This must be an even number. It is the next-highest even number greater than or equal to the product of the width in pixels and the number of color bits per pixel. Each row of pixels must be padded at the right end so that it has an even number of bytes.

Except for monochrome bitmaps (which every raster output device can handle) these old *Windows* bitmaps are very closely linked to the output device for which they were designed. There is nothing in the bitmap that indicates how multiple color bits or multiple color planes correspond to a particular color. This is a serious problem and severely limits the use of color bitmaps.

WINDOWS 3.0 BITMAP FORMAT

```
typedef struct tagBITMAPFILEHEADER
  {
  WORD  bfType ;              // set to 'BM' for bitmaps
  DWORD bfSize ;              // size of the file in bytes
  WORD  bfReserved1 ;         // set to 0 for bitmaps
  WORD  bfReserved2 ;         // set to 0 for bitmaps
  DWORD bfoffBits ;           // offset of bitmap data from top of file
  }
  BITMAPFILEHEADER ;

typedef struct tagBITMAPINFOHEADER
  {
  DWORD   biSize ;            // size of information header (40)
  DWORD   biWidth ;           // width of bitmap in pixels
  DWORD   biHeight ;          // height of bitmap in pixels
  WORD    biPlanes ;          // set to 1
  WORD    biBitCount ;        // number of color bits per pixel
  DWORD   biCompression ;     // compression algorithm
  DWORD   biSizeImage ;       // size of the bitmap data if compressed
  DWORD   biXPelsPerMeter ;   // horizontal resolution in pixels per meter
  DWORD   biYPelsPerMeter ;   // vertical resolution in pixels per meter
  DWORD   biClrUsed ;         // number of colors used.
  DWORD   biClrImportant ;    // number of important colors
  }
  BITMAPINFOHEADER ;

typedef struct tagBITMAPINFO
  {
  BITMAPINFOHEADER bmiHeader ;      // BITMAPINFOHEADER structure
  RGBQUAD          bmiColors[1] ;   // array of RGBQUAD structures
  }
  BITMAPINFO ;

typedef struct tagRGBQUAD
  {
  BYTE rgbBlue ;                // blue value
  BYTE rgbGreen ;               // green value
  BYTE rgbRed ;                 // red value
  BYTE rgbReserved ;            // set to 0
  }
  RGBQUAD ;
```

Figure 3: The device-independent bitmap structures defined in the *Windows* 3.0 header file.

THE NEW BITMAP FORMATS

The new bitmap formats in OS/2 and *Windows* 3.0 incorporate some basic changes over the old *Windows* bitmap format.

First, although a field exists that denotes the number of color planes, this field should always be set to 1. The *Windows* 3.0 documentation states this very clearly. The OS/2 documentation does not. However, OS/2 documentation has never defined the format of multiplane bitmap data.

How does this impact the EGA and VGA, in which video memory is organized in color planes? Not at all. Bitmaps for 16-color multiplane video adapters use 4 consecutive color bits per pixel. The device driver is responsible for converting this data into an appropriate format for displaying the bitmap on the screen.

Second, the number of color bits should be set to 1, 4, 8, or 24, for bitmaps capable of representing 2, 16, 256, or 16 million colors, respectively. Again, the *Windows* 3.0 documentation comes straight out and says this. The OS/2 documentation indicates that these values create "standard bitmaps."

Third, the bitmap data begins with the bottom row of pixels rather than the top. This is in accordance with the use of the lower-left corner as the coordinate origin in GPI.

Fourth, in the old *Windows* bitmap, each row of pixels contains an even number of bytes. In the new formats, the number of bytes in each row of pixels must be a multiple of 4.

Fifth, the new bitmap formats contain a color table that allows different output devices to intelligently handle bitmaps with more colors (or different colors) than the output device can render.

THE FOUR FILE SECTIONS

An OS/2 bitmap file or a *Windows* 3.0 device-independent bitmap file has four general sections. These are (in the order in which they appear in the file):

- The bitmap file header. This is a 14-byte header that's the same for the bitmap file formats in OS/2 1.1, *Windows* 3.0, and OS/2 2.0.
- The bitmap information header. This contains information about the bitmap—most importantly the width and height of the image in pixels—and the number of bits that correspond to each pixel. This bitmap information header is 12 bytes in OS/2 1.1, 40 bytes in *Windows* 3.0, and 64 bytes in OS/2 2.0. The first word in this structure indicates the size of the bitmap information block, so the three formats can be easily differentiated.
- The color table. This is a collection of 24-bit red-green-blue values. There are as many entries in the color table as there are colors in the bitmap; either 2, 16, or 256. The color table isn't present for bitmaps with 24 color bits because each pixel is represented by a 24-bit red-green-blue value.
- The bitmap data. As I mentioned previously, this is stored beginning with the bottom row of pixels. The first byte of each row corresponds to the leftmost pixels, beginning with the most-significant bits. Each row must be padded at the right to contain a multiple of 4 bytes.

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ADDITIONAL WINDOWS 3.0 STRUCTURES FOR HANDLING OS/2 BITMAPS

```
typedef struct tagBITMAPCOREHEADER
  {
  DWORD bcSize ;                  // size of information header (12)
  WORD  bcWidth ;                 // width of bitmap in pixels
  WORD  bcHeight ;                // height of bitmap in pixels
  WORD  bcPlanes ;                // set to 1
  WORD  bcBitCount ;              // number of color bits per pixel
  }
  BITMAPCOREHEADER ;

typedef struct tagBITMAPCOREINFO
  {
  BITMAPCOREHEADER bmciHeader ;    // BITMAPCOREHEADER structure
  RGBTRIPLE        bmciColors[1] ; // array of RGBTRIPLE structures
  }
  BITMAPCOREINFO ;

typedef struct tagRGBTRIPLE
  {
  BYTE rgbtBlue ;                 // blue value
  BYTE rgbtGreen ;                // green value
  BYTE rgbtRed ;                  // red value
  }
  RGBTRIPLE ;
```

Figure 4: These structures are defined in WINDOWS.H for working with OS/2 1.1 bitmaps in a *Windows* program.

THE OS/2 1.x STRUCTURES

Let's begin with the earliest manifestation of this bitmap format in OS/2 1.1. Figure 2 illustrates four structures that are defined in the two header files, PMBITMAP.H and PMGPI.H.

The file begins with the information shown in the BITMAPFILEHEADER structure. The usType field contains the characters BM, which is the short integer 0x4D42. This field can also contain IC, PT, CI, and CP, for an icon, mouse pointer, color icon (beginning in OS/2 1.2), and color pointer (in OS/2 1.2 and later); but for purposes of simplicity I'll ignore these other forms of bitmap files.

The cbSize field contains the size of the file in bytes, and the offBits field is the offset of the bitmap data from the beginning of the file.

This information is followed by a BITMAPINFOHEADER (bitmap information header) structure, also shown in Figure 2.

The cbFix field is the size of this structure in bytes and must be set to 12. The structure contains fields for the width and height of the bitmap in pixels as well as the number of color bits per pixel.

The BITMAPINFO structure is similar to the BITMAPINFOHEADER structure, but the last field is another structure (named RGB) for the first entry of the color table. In a future issue, I'll discuss how this BITMAPINFO structure is used.

The RGB structure contains three fields, for red, green, and blue primary color values. These may range from 0 to 255. If all 3 bytes are 0, the color is black, if all 3 bytes are 255, the color is white.

The color table contains a red-green-blue entry for each color used in the bitmap. Suppose that the bitmap has 4 color bits for 16 colors. Each pixel requires 4 bits. These 4 bits can range in value from 0 to 15. This value is an index into the 16 colors in the color table.

WINDOWS 3.0 ENHANCEMENTS

Figure 3 shows four structures defined in the WINDOWS.H header file that was included in the *Windows* 3.0 Software Development Kit (SDK). These structures define the extension of the OS/2 1.1 bitmap format for *Windows*.

First, notice that the fields of the BITMAPFILEHEADER structure for *Windows* 3.0 are identical to the first five fields of the BITMAPFILEHEADER in OS/2 1.1, but they have different field names. The *Windows* WORD data type is the same as the OS/2 USHORT data type—a 16-bit unsigned integer; the *Windows* DWORD data type is the same as the OS/2 ULONG data type—a 32-bit unsigned integer.

The BITMAPINFOHEADER structure differs from the OS/2 1.1 structure. The biSize field should indicate a size of 40 bytes. The width and height of the bitmap are now represented by 32-bit integers rather than 16-bit integers.

There are also six more fields. The biCompression field denotes bitmap compression and can be set to the identifier BI_RGB (indicating no compression and equal to 0), BI_RLE8 (equal to 1), and BI_RLE4 (equal to 2). These are run-length encoded algorithms, but they are not the same as those algorithms used in .PCX files.

The biSizeImage field is the size of the bitmap data in bytes and is only required if the bitmap data is compressed; otherwise it can be set to 0.

The biXPelsPerMeter and biYPelsPerMeter contain the resolution of the bitmap in pixels per meter. This can assist programs in expanding or compressing bitmaps to preserve a correct aspect ratio and image size. Suppose that a scanner is capable of 300-dot-per-inch (11,811 pixels per meter) resolution. The scanner software would put 11,811 in each of these two fields. A program that displayed such a bitmap on a VGA might compress the bitmap so that it appeared the same size as the original scanned image. These fields can be set to 0 if this information is not important or not available.

The biClrUsed field can be set to 0 (which means that all colors are used) or something less than the number of colors implied by the biBitCount field. This allows the bitmap file to contain a smaller color table than would otherwise be required. For example, a 64-color bitmap would still have 8 bits per pixel but the biClrUsed would be 64 and the color table would contain only 64 entries.

The biClrImportant field can be set to 0 (which means that all colors are important) or something less than the number of colors implied by the biClrUsed field. This can assist a device driver in rendering a bitmap on a device that cannot display as many colors as are in the bitmap.

The color table is also different in this revision to the OS/2 1.1 bitmap format: Rather than 3 bytes per entry, the *Windows* 3.0 bitmap format has 4 bytes per entry with the last byte set to 0.

The WINDOWS.H header file in *Windows* 3.0 also includes three additional structures that define the OS/2 1.1 bitmap format. These are shown in Figure 4. These structures allow a *Windows* 3.0 program to easily handle OS/2 1.1 bitmaps.

THE OS/2 2.0 FORMAT

Most recently, the beta OS/2 2.0 SDK has revealed a new bitmap format that is an extension of the *Windows* 3.0 bitmap format. The three new structures are shown in Figure 5. Notice that these structures have the same names as the OS/2 1.1 bitmap structures except that a 2 is appended to the name.

There are eight new fields in the BITMAPINFOHEADER structure, and some other differences. One difference is that the only value currently accepted for the ulCompression field is BCA_UNCOMP (uncompressed), which is defined as 0. I assume that identifiers denoting the run-length encoding of *Windows* 3.0 bitmaps will be defined in the future.

Notice that the biXPelsPerMeter and biYPelsPerMeter fields in the *Windows* 3.0 BITMAPINFOHEADER structure are called cxResolution and cyResolution in the OS/2 2.0 BITMAPINFOHEADER2 structure. The usUnits field indicates the units of resolution of the cxResolution and cyResolution fields. The only value currently accepted in this field is BRU_METRIC (defined as 0), which means that the resolution is in pixels per meter. Conceivably, other identifiers defined in the future could allow these resolution fields to indicate pixels per inch or something else.

The usReserved field is reserved and should be set to 0. The usRecording field indicates how the bitmap data is stored. Currently, the only accepted value is BRA_BOTTOMUP (defined as 0), which means the bitmap data begins with the bottom row of bits. In the future, this field may indicate that the bitmap data begins with the top row of bits, or that each scan line begins with the rightmost bits rather than the leftmost bits. (The TIFF format allows these variations.)

The usRendering, cSize1, and cSize2 fields are used to describe the halftone algorithm used to digitize the image. I'm afraid that the subject of digital halftoning algorithms is beyond the scope of this column (as well as my knowledge). We'll let the scanner manufacturers worry about these fields.

The only value currently accepted for the ulColorEncoding field is BCE_RGB (defined as 0). But this field leaves open the possibility of defining color in different ways, such as cyan-magenta-yellow, which is more common on printers.

The ulIdentifier field is reserved for application use: you can put anything you want here. For example, if your program deals with a lot of bitmaps and you want to associate each bitmap with a descriptive name, you can set this field to a pointer to an ASCII string.

For all the new information header fields, a default value is indicated by 0. Thus, when converting an OS/2 1.1 bitmap to the OS/2 2.0 format, you simply copy the fields common to both structures and zero out the other fields.

Note that not all of this information needs to be present: the preliminary OS/2 2.0 documentation indicates that the BITMAPINFOHEADER2 information could be truncated anytime after the cBitCount field. In this case, the first field (called cbFix) indicates the length of the structure in the file and where the color table begins.

If you were reading a bitmap file, you'd first read the top of the file into a BITMAPFILEHEADER structure and check that the first 2 bytes are BM. Then you'd read in the next ULONG. If it has a value of 12, you're dealing with an OS/2 1.1 bitmap. Any value of 16 or higher indicates a *Windows* 3.0 or OS/2 2.0 bitmap format.

But I'm getting ahead of myself. In a future column, I'll show you some OS/2 2.0 code that reads and writes bitmap files in all three formats. ■

THE OS/2 2.0 BITMAP FORMAT

```
typedef struct _BITMAPINFOHEADER2  // standard prefix is 'bmp'
  {
  ULONG  cbFix ;                   // size of information header (64)
  ULONG  cx ;                      // width of bitmap in pixels
  ULONG  cy ;                      // height of bitmap in pixels
  USHORT cPlanes ;                 // set to 1
  USHORT cBitCount ;               // number of color bits per pixel
  ULONG  ulCompression ;           // compression algorithm
  ULONG  cbImage ;                 // size of the bitmap data if compressed
  ULONG  cxResolution ;            // horizontal resolution
  ULONG  cyResolution ;            // vertical resolution
  ULONG  cclrUsed ;                // number of colors used
  ULONG  cclrImportant ;           // number of important colors
  USHORT usUnits ;                 // units of resolution
  USHORT usReserved ;              // set to 0
  USHORT usRecording ;             // orientation of bitmap data
  USHORT usRendering ;             // halftone algorithm
  ULONG  cSize1 ;                  // used with halftone algorithm
  ULONG  cSize2 ;                  // used with halftone algorithm
  ULONG  ulColorEncoding ;         // format of color table
  ULONG  ulIdentifier ;            // for application use
  }
  BITMAPINFOHEADER2 ;

typedef struct _RGB2               // standard prefix is 'rgb2'
  {
  BYTE bBlue ;                     // blue value
  BYTE bGreen ;                    // green value
  BYTE bRed ;                      // red value
  BYTE bReserved ;                 // set to 0
  }
  RGB2 ;

typedef struct _BITMAPINFO2        // standard prefix is 'bmi2'
  {
  ULONG  cbFix ;                   // size of information header (64)
  ULONG  cx ;                      // width of bitmap in pixels
  ULONG  cy ;                      // height of bitmap in pixels
  USHORT cPlanes ;                 // set to 1
  USHORT cBitCount ;               // number of color bits per pixel
  ULONG  ulCompression ;           // compression algorithm
  ULONG  cbImage ;                 // size of the bitmap data if compressed
  ULONG  cxResolution ;            // horizontal resolution
  ULONG  cyResolution ;            // vertical resolution
  ULONG  cclrUsed ;                // number of colors used
  ULONG  cclrImportant ;           // number of important colors
  USHORT usUnits ;                 // units of resolution
  USHORT usReserved ;              // set to 0
  USHORT usRecording ;             // orientation of bitmap data
  USHORT usRendering ;             // halftone algorithm
  ULONG  cSize1 ;                  // used with halftone algorithm
  ULONG  cSize2 ;                  // used with halftone algorithm
  ULONG  ulColorEncoding ;         // format of color table
  ULONG  ulIdentifier ;            // for application use
  RGB2   argb2Color[1] ;           // array of RGB2 structures
  }
  BITMAPINFO2 ;
```

Figure 5: The new bitmap structures defined in the OS/2 2.0 header files.

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by
Ray Duncan

Power Programming

Examining the Development of Semaphores in OS/2

A *multitasking operating system* is, by definition, an environment that allows two or more programs to execute concurrently. But taken alone, multitasking in a single-user system such as OS/2 is of dubious value. The true benefits of multitasking do not become apparent unless the operating system also supports efficient and flexible means of interprocess communication (IPC)—mechanisms by which programs can cooperate and exchange information.

As it happens, OS/2 is extraordinarily rich in interprocess communication facilities. The basic OS/2 system supports no fewer than five basic types of IPC: semaphores, shared memory, pipes, queues, and signals. And when LAN Manager is running, an additional IPC mechanism—in the mailslot—is also available. Thus, the OS/2 software developer is blessed with many options when he wishes to pass information between multiple threads in the same process, two or more processes on the same machine, or even between processes running on different nodes of a network.

The blessings aren't unmixed, though. Every new version of OS/2 has brought with it significant changes in the application program interface (API), and OS/2 2.0 is no exception. OS/2 2.0's 32-bit API is, in fact, a far worse offender in this area than any previous release. The IPC functions in three categories—semaphores, shared memory, and signals—have been totally revamped, and the pipe functions have undergone generalized (though often trivial) name changes. Only the queue functions have survived unscathed, and this is little comfort, because the queue functions are so slow and clumsy that hardly anyone uses them.

OS/2 2.0 IPC is a complex subject, and I won't pursue it in excruciating detail in this column. But I'd like to single out OS/2 2.0 semaphores for a more extensive discussion, because in many ways they exemplify the difficulties that have buffeted OS/2 software developers over the last three years.

■ In many ways, the evolution of semaphores typifies the difficulties OS/2 software developers have had to contend with over the past few years.

THE USES OF SEMAPHORES

Semaphores can be thought of as simple objects that are always in one of two states. They are useful for communication between tasks, because the state can be tested and changed by the tasks that have access to the semaphore. Semaphores are used in two distinctly different ways: for *signaling* or for *mutual exclusion*.

When you use a semaphore for signaling between threads or processes, its state is said to be either *set* or *clear*. Typically, one thread or process plays an active role by first setting the semaphore and then clearing it upon the occurrence of some event. Other threads or processes that wish to be notified of the event play a more passive role; they merely issue a semaphore wait function call that doesn't complete until the semaphore has been cleared or a timeout interval has elapsed.

When a semaphore is being used for mutual exclusion, its state is described as either *owned* or *available*. In this model, the semaphore symbolizes a resource (such as a file or a data structure) that would be corrupted if it were manipulated by more than one task at a time. To prevent such damage, tasks cooperate by refraining from accessing the resource unless they own the corresponding semaphore. Here, all tasks play an active role in manipulating the semaphore; they compete for ownership of the semaphore but are not otherwise dependent on each others' actions.

OS/2 1.x SEMAPHORES

The 16-bit 80286 versions of OS/2 implement three distinct types of semaphores, each with its own characteristics and limitations: system semaphores, RAM semaphores, and fast-safe RAM semaphores. Unfortunately, the differences among these three species are *not* based on the classic distinction of function, that is, between signaling and mutual exclusion.

System semaphores are named, global objects, which reside outside every process's memory space and are completely under the control of the operating system; they can be used for either signaling or mutual exclusion. Only a limited number of system semaphores are available, and they must be *created* or *opened* with a system call that returns a handle for subsequent access to the semaphore. When system semaphores are used for mutual exclusion, they support *counting;* that is, a process can make *nested* requests for ownership of the semaphore, and the semaphore will not become available again until a corresponding number of release calls have been issued. OS/2 also provides cleanup support for system semaphores; if a process dies owning a semaphore that another process is waiting for, that other process will be notified with a unique error code.

RAM semaphores, on the other hand, reside in memory controlled by a process. In fact, a RAM semaphore is merely a properly initialized double word of memory within the application's address space, and the handle for a RAM semaphore is just a far pointer to this double word—no open or create operation is required. Consequently, the number of RAM semaphores that a process may use is limited only by the amount of virtual memory it can allocate. RAM semaphores are typically used to communicate among threads, but since memory segments can be shared, they can also be used to communicate among processes. The chief weaknesses of RAM semaphores are that, although they can be used for either signaling or mutual exclusion, they do not support counting and they do not receive any cleanup support from the operating system.

Fast-safe RAM semaphores, which first appeared in OS/2 1.1, are the duck-billed platypuses of IPC. They combine some characteristics of both system semaphores and RAM semaphores and are thus more feeble than either. Fast-safe semaphores reside in the application's memory space, so there is not a systemwide limit on their number, but this advantage is offset by their bulkiness (14 bytes each). They support mutual exclusion and counting and are endowed with a certain amount of cleanup support by the operating system. But they can't be used for signaling, and they must be manipulated with special function calls that are not orthogonal to the rest of the semaphore API.

The OS/2 1.*x* semaphore API functions are listed in Figure 1. You'll immediately notice that there's considerable overlap and asymmetry in the semaphore API. Some functions can operate on more than one type of semaphore for either signaling or mutual exclusion; others work with more than one semaphore type but support only one usage; and still others support only one semaphore type *and* one usage. This overlap and asymmetry is demonstrated more clearly reading across the rows or down the columns of Figure 2.

THE OS/2 1.*x* 16-BIT SEMAPHORE API

Semaphore API	Function
DosCloseSem	Close system semaphore
DosCreateSem	Create system semaphore
DosFSRamSemClear	Release fast-safe RAM semaphore
DosFSRamSemRequest	Obtain ownership of fast-safe RAM semaphore
DosMuxSemWait	Wait for any of several semaphores to be clear
DosOpenSem	Open existing system semaphore
DosSemClear	Release ownership of system semaphore or RAM semaphore, or unconditionally clear system semaphore or RAM semaphore
DosSemRequest	Obtain ownership of system semaphore or RAM semaphore
DosSemSet	Unconditionally set system semaphore or RAM semaphore
DosSemSetWait	Unconditionally set system semaphore or RAM semaphore and wait until it is clear
DosSemWait	Wait until system semaphore or RAM semaphore is clear

Figure 1: The two fast-safe RAM semaphore functions are supported in OS/2 2.0 for compatibility with 16-bit protected-mode applications, but they can't be easily invoked by 32-bit applications.

PROBLEMS WITH OS/2 1.*x* SEMAPHORES

Time and experience have convinced most developers that the OS/2 1.*x* semaphore API is dangerously flawed at several levels. The most superficial level is simply the names assigned to the functions; some follow the "verb-object" convention (DosOpenSem), while others were formed on an "object-verb" template (DosSemSet). This irrationality in naming is hardly a life-or-death issue, but it suggests that the semaphore API was cobbled together by a committee rather than thoughtfully and methodically designed.

At the most fundamental level, the semaphore API contains ambiguities that are a minefield for the application programmer. For example, many of the semaphore functions can manipulate either system or RAM semaphores, using the same calling syntax. But the parameter that *identifies* the semaphore is semantically different in each case: for a RAM semaphore, it's a far pointer to a ULONG that *is* the semaphore, while for a system semaphore, the parameter is a semaphore handle that is retrieved from an HSEM variable. The compiler can't detect coding errors here because, while it does recognize syntactic errors, it's generally helpless when confronted with semantic errors. The potential for confusion is exacerbated by Microsoft's C-language-specific documentation and the multiple layers of macros, typedefs, and manifest constants in the OS/2 API header files.

There is another fundamental weakness in OS/2 1.*x*'s semaphore support. Semaphores are divided into different types based on performance and storage placement rather than on usage. This makes it possible for applications to inadvertently come into conflict when they access the same semaphore, and the operating system will not defend them against such a conflict. For instance, if one task is using a RAM semaphore in a shared memory segment for mutual exclusion but another task issues a DosSemClear against the same semaphore, as though it were being used for signaling, no error will be returned to either process, but the result will be (to put it kindly) unpredictable.

As it turns out, an original reason for the distinction between system and RAM semaphores—performance—has proven largely irrelevant in practice. Setting or clearing a RAM semaphore is only about twice as fast as setting or clearing a system semaphore. A factor-of-ten difference in performance would have far better justified systemwide support of two types of semaphores. RAM semaphores are located in the process's address space and are therefore swappable; thus even this relatively small performance advantage can't be assured at runtime; if the segment that holds a RAM semaphore is swapped out to disk, a reference to the semaphore could be delayed for tens of milliseconds while the segment is rolled back in. System semaphores, on the other hand, reside in memory controlled by the operating system, so their access times are quite consistent.

Finally, the special capabilities of system semaphores have ensured that they have become a critical—and sometimes application-limiting—system resource. System semaphores are the only semaphore type with fully generalized support for counting and cleanup, and they are also the only type that can be accessed by a device driver at interrupt time regardless of the current CPU mode. In order for the system semaphores to be addressable in ei-

ther real mode or protected mode, they must be located below the 640K boundary, which means that the total number of system semaphores available is severely constrained by the competing goal of maximizing the memory available for the DOS Compatibility Environment. The situation is worsened because OS/2 itself uses up many of the available system semaphores.

OS/2 1.x SEMAPHORE TYPE AND USAGE

Operation	System semaphore	RAM semaphore	Fast-safe RAM semaphore
	Semaphore type		
Create	DosCreateSem	N/A	N/A
Open	DosOpenSem	N/A	N/A
Close	DosCloseSem	N/A	N/A
Set	DosSemSet	DosSemSet	N/A
Clear	DosSemClear	DosSemClear	N/A
Request	DosSemRequest	DosSemRequest	DosFSRamSemRequest
Release	DosSemClear	DosSemClear	DosFSRamSemClear

Figure 2: The relationship of the different OS/2 1.x semaphore functions to the semaphore types.

OS/2 2.0 SEMAPHORES

The designers of OS/2 2.0's 32-bit API were determined to solve the historical problems in the 16-bit semaphore API. They met this goal, but their solution was radical: they discarded the model used by the 16-bit semaphore API rather than repairing or extending it. The 32-bit API supports three totally new species of semaphores—mutual exclusion (mutex) semaphores, event (signaling) semaphores, and multiple-wait (muxwait) semaphores—and three new, disjoint sets of API functions to manipulate them. The 32-bit semaphore API is summarized in Figure 3.

The usage of the new semaphore types and the intent of the new API functions are pretty much obvious from their names, so I won't digress into programming details here. It's more important to look at global implications of the new 32-bit semaphore model. There are four that I consider most important:

- The distinction between RAM and system semaphores no longer exists. All semaphores are controlled by the system, all must be created before they can be used, all reside in memory that is swappable (unless the memory has been explicitly locked down by a device driver for performance reasons), and all can be cleaned up if a process or thread using a semaphore dies unexpectedly.
- All 32-bit semaphores are nameable and therefore shareable between processes. If a process will only use the semaphore internally (that is, between threads) and wishes to ensure that no other process can access the semaphore, it need only supply a null string as the semaphore's name when the semaphore is created.
- There is no longer any chance of an inconsistency in the way two processes or threads access a 32-bit semaphore. If you use the wrong API call with a particular semaphore, an error code will be returned, but there will be no other damage; a logical error in one task is much less likely to interfere with the proper execution of other, correctly programmed tasks.
- The new semaphore types and APIs make it impractical for 32-bit applications to use semaphores for communication with existing 16-bit applications or device drivers. The 32-bit API functions will not operate on 16-bit semaphores, and vice versa. It's theoretically feasible for a 32-bit application to control 16-bit semaphores by means of mixed-mode execution and direct calls to the 16-bit API entry points. But the code involved is messy and inefficient, so developers are likely to avoid it if possible.

THE COSMIC PERSPECTIVE

The 32-bit semaphores in OS/2 2.0 demonstrate that IBM and Microsoft are not afraid to make a clean break with a defective initial design, replacing it with a superior design based on practical experience. This flexibility and commitment to quality is laudable. However, as we've seen in this column, there's also a Dark Side to the his-

THE OS/2 2.0 32-BIT SEMAPHORE API

Event (signaling) semaphore APIs	Function
DosCloseEventSem	Close event (signaling) semaphore
DosCreateEventSem	Create event (signaling) semaphore
DosOpenEventSem	Return handle for event (signaling) semaphore
DosPostEventSem	Set event (signaling) semaphore
DosQueryEventSem	Return state of event (signaling) semaphore
DosResetEventSem	Clear event (signaling) semaphore
DosWaitEventSem	Wait for event (signaling) semaphore to be cleared
Mutual-exclusion semaphore APIs	**Function**
DosCloseMutexSem	Close mutual-exclusion semaphore
DosCreateMutexSem	Create mutual-exclusion semaphore
DosOpenMutexSem	Return handle for mutual-exclusion semaphore
DosQueryMutexSem	Return state of mutual-exclusion semaphore
DosReleaseMutexSem	Release ownership of mutual-exclusion semaphore
DosRequestMutexSem	Wait for ownership of mutual-exclusion semaphore
Multiple-wait semaphore APIs	**Function**
DosAddMuxWaitSem	Add semaphore to multiple-wait list
DosCloseMuxWaitSem	Close multiple-wait semaphore
DosCreateMuxWaitSem	Create multiple-wait semaphore list
DosDeleteMuxWaitSem	Remove semaphore from multiple-wait list
DosOpenMuxWaitSem	Return handle for multiple-wait semaphore list
DosQueryMuxWaitSem	Return state of multiple-wait semaphore list
DosWaitMuxWaitSem	Wait for one of a list of semaphores to be cleared

Figure 3: The functions are divided into three groups. The action of each group—unlike OS/2 1.x semaphore API functions—is confined to a single type of semaphore.

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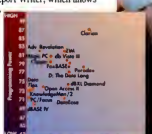

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tory of the OS/2 semaphore API:

- The semaphore API in OS/2 1.0 was poorly thought out and was significantly prone to misuse—in spite of a long period of alpha and beta testing and developer feedback.
- In OS/2 1.1, Microsoft and IBM attempted to paper over some of the semaphore problems by grafting yet another type of semaphore and additional API functions into the system. These additions accomplished little other than to clutter up the API; they were almost universally ignored by developers.
- In OS/2 2.0, in spite of many Microsoft and IBM promises of easy migration to 32-bit programming, there was a complete discontinuity between the 16-bit and 32-bit semaphore APIs.
- Programmers who invested time and effort in OS/2 1.*x*, used the 16-bit OS/2 header files hoping for portability, and followed all the Microsoft and IBM guidelines, have only been rewarded in OS/2 2.0 with a new API to learn and a glaring lack of conversion aids.
- The OS/2 1.*x* documentation for the semaphore API has ranged from vague and incomplete to frankly misleading. And in OS/2 2.0, there is no printed documentation whatsoever; developers who are dissatisfied with the fragmented on-line programming information must create their own documentation or do without.

The mutations in the semaphore API from OS/2 1.0 through OS/2 2.0 are a microcosm of the evolution of, and difficulties with, OS/2 as a whole. OS/2 can't succeed without application programs, but Microsoft and IBM have shown themselves oblivious to the effect of a constantly shifting API on independent software developers. Every release of OS/2 to date has broken existing code, and worse yet, the product life cycle of the operating system has been shorter than that of most applications. If Microsoft and IBM really want OS/2 to succeed, this pattern cannot continue.

THE IN-BOX

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by William S. Hall

Windows

FIXING AN UNRESPONSIVE MOUSE

When I boot my machine, I've occasionally observed that MOUSE.SYS doesn't recognize the Microsoft Mouse. To get around the problem, I've been using MOUSE .COM, but this in turn causes trouble when I try to run a DOS application from *Microsoft Windows*. Specifically, *Windows* reports "COM in use" and "Insufficient Memory." After some experimentation, I found that these messages go away if I run MOUSE .COM immediately after loading MOUSE. SYS, and that *Windows* works fine and produces no error messages. I've also noticed that although both drivers seem to have been loaded, a check of resident programs does not show MOUSE.COM present.

Mark Furrier
Somerset, New Jersey

PC MAGAZINE MOUSE.COM sometimes has problems if the number of buffers in CONFIG.SYS is large; the mouse can be fully operational but still report an error message. Try reducing your buffers and see if that helps; 20 is the maximum you should have. If you're using SMARTDRV, 10 is even better.

That MOUSE.SYS doesn't always work, however, indicates that you probably have a problem with the mouse hardware. One of the first things to check is whether a network card or other peripheral isn't grabbing the interrupt.

If your mouse uses a serial port, you must be sure the appropriate interrupt for that port (4 for COM1, 3 for COM2) is available and not being taken by another peripheral. (Currently, *Windows* cannot use COM3 or COM4 for mouse input.)

Problems with a bus mouse usually appear because the bus mouse interrupt jumper is not set correctly. The rules are fairly simple: On an XT class machine, use interrupt 2 for the mouse. If this causes a conflict with a network card, you may need to move the interrupt jumper to 3 (if you don't need COM2) or 4 (if you are not using COM1). Do not use 5 on the XT.

- **FIXING AN UNRESPONSIVE MOUSE: Here's what to check when your mouse won't work.**
- **GETTING CONTROL OF THE KEYBOARD: Making the keys work properly in terminal emulation.**
- **USING MULTIPLE PRINTERS IN WINDOWS: How to access several printers from the same physical port.**
- **SAVING MOUSE-DRIVER MEMORY: You may not need to load a mouse driver.**
- **A LOOK AT HIMEM.SYS: How *Windows* manages extended memory.**

On an AT-class machine, interrupt 5 is the first choice for the mouse, followed by 3, and then 4. Don't use interrupt 2.

GETTING CONTROL OF THE KEYBOARD

I came across something in the *Windows* 3.0 Terminal program that will be helpful for anyone using the program.

In the two emulation modes provided, VT52 and VT100, an effort has been made to obtain some of the keyboard functionality of these two terminals. But you must first activate the Scroll Lock key. For example, if Scroll Lock is off, the Arrow keys simply move the editing caret around the screen. However, when Scroll Lock is on, the Arrow keys send the appropriate VT100 or VT52 escape sequences.

John Talierfo
Hartsdale, New York

PC MAGAZINE This could be very confusing for someone stumbling around in a terminal session. It should be noted in the manual but isn't.

USING MULTIPLE PRINTERS IN WINDOWS

I have access to several printers but only have one parallel port. It's not ideal, but I've found a way to deal with it. DOS doesn't care whether you call the printer attached to Port 1 LPT1 or LPT1.*XXX*, where XXX is arbitrary. However, *Windows* will recognize such names as files. So, if you replace the LPT1:= entry in WIN.INI under the [ports] entry with names like

```
LPT1.HP=
LPT1.OKI=
```

you can then attach several printers to the same physical port using the control panel.

Deborah Hardin
Providence, Rhode Island

PC MAGAZINE This solution works, and if you need to, you can extend this idea to LPT2 and LPT3 as well.

SAVING MOUSE-DRIVER MEMORY

None of my DOS applications requires a mouse. Do I still have to load an MS-DOS mouse driver for *Windows*? And why does *Windows* 3.0 provide files like MOUSE .COM and MOUSE.SYS on the distribution disks? When I tried running MOUSE.COM, my system crashed.

Alex Alten
San Jose, California

PC MAGAZINE *Windows* provides its own mouse driver. The setup program for *Windows* 2.0 installs it and the other device drivers as a part of WIN-200.BIN. In *Windows* 3.0, it's a separate file in the SYSTEM directory with a .DRV suffix. The mouse driver is actually a *Windows* dynamic link library that exports calls relating to its activation and deactivation and handles the hardware interrupt

generated when the mouse is moved or its buttons depressed and released. The state information read at interrupt time is passed on to *Windows*, which calls the display driver to redraw the cursor if necessary and then hands over the information to the program controlling the screen where the event happened.

So if none of your standard applications requires a mouse, then you can save a few thousand bytes of conventional memory by not installing the driver in DOS. On the other hand, if you plan to use DOS applications from *Windows* and you have a Microsoft Mouse, you'll need to upgrade your DOS drivers. You can use the files provided, but first you must unpack them using the EXPAND utility on Disk 2. You can get the syntax by just typing EXPAND once you've logged on to Disk 2. Both MOUSE.COM and MOUSE.SY$ are packed, although only the latter indicates this fact with the $. And if you do not unpack MOUSE.COM before trying it out, you will crash.

A LOOK AT HIMEM.SYS

What is HIMEM.SYS and why does the documentation for *Microsoft Windows* recommend using it. Is this an expanded memory manager?

Steve Letiere
Philadelphia, Pennsylvania

HIMEM's function is to arbitrate the use of extended memory in *Windows;* it did in *Windows* 2.*x*, and it continues to in *Windows* 3.0.

Windows 3.0 won't run in standard or enhanced mode without HIMEM. Also, RAMDRIVE and SMARTDRV require HIMEM to be present when they are using extended memory.

HIMEM also provides a feature for real-mode *Windows* that was not in *Windows/286*: *code caching*. To understand this, let's look at the way *Windows* uses memory.

Code and data in *Windows* applications are divided into segments of 64K or less in length. A segment is assigned certain attributes, such as *movable*, *discardable*, and *preload*, which determine how *Windows* deals with it. If a segment is discardable, *Windows* can forget about it when it's not in use. This means that the area in memory the segment occupies can be overwritten. Later, if the segment is needed, it is reloaded from disk by reading that part of the program's executable file containing the segment. Data segments would never be marked as discardable, since rereading would reinitialize everything!

In real-mode *Windows*, a lot of segments are discarded, since *Windows* programs are often larger than the available memory. However, if extended memory is available and HIMEM.SYS is installed, *Windows* will copy a segment being discarded to extended memory. Then, instead of having to reload the segment from disk, *Windows* can fetch it from extended memory whenever it's needed, resulting in considerably faster performance.

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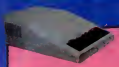

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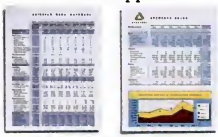

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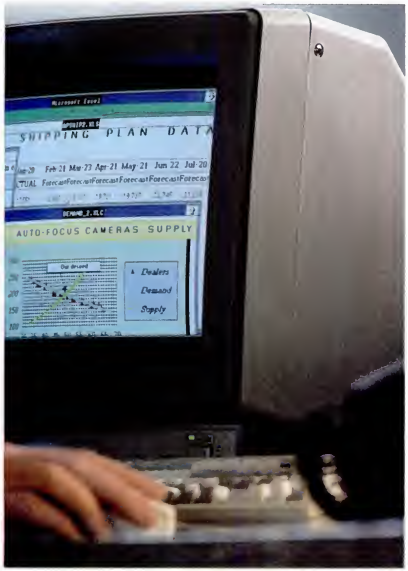
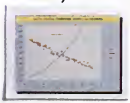


toward graphical platforms like Microsoft® Windows, MS® OS/2 Presentation Manager and, of course, the Macintosh.® It's a simple reality. Which means serious spreadsheet users are suddenly faced with a decision.



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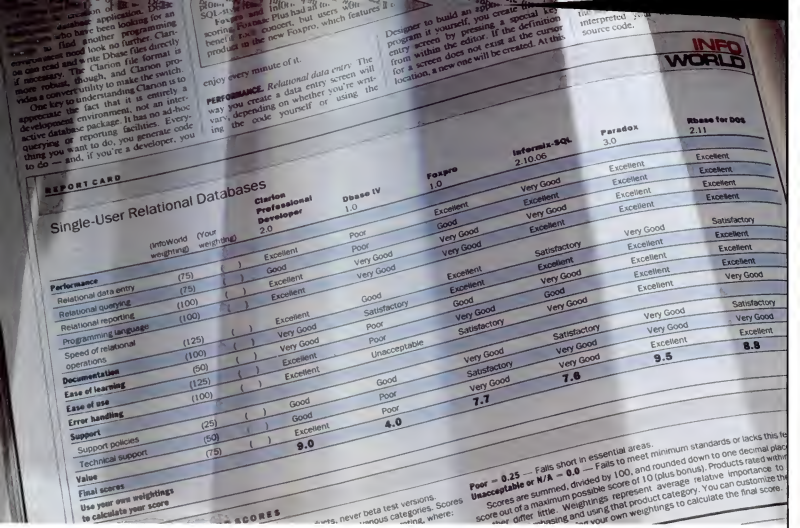

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edited by
Trudy Neuhaus

Databases

CLIPPER CURSOR CONTROL

Clipper allows programmers to SET CURSOR ON and OFF, but this command does not work with MENU TO or ACHOICE menus. These built-in functions turn the cursor off, completely disregarding the programmer's wishes.

For example, suppose that several READs are followed by a MENU TO on the same screen. Because MENU TO turns the cursor off, the user has no visual cue as to where the program *is* at any given moment. Of course, if he uses his Arrow keys, he can see the moving prompt bar. But it's inelegant to put the user in doubt.

To get around this, type

```
PROC curson
SET KEY 250 TO cursonx
IF NEXTKEY()=0
  KEYB CHR(250)
ENDI
RETU

PROC cursonx
SET CURS ON
RETU
```

Now the cursor will be turned on inside MENU TO when this code executes:

```
@ 24,10 PROMPT " Append  "
@ 24,35 PROMPT "  Edit   "
@ 24,60 PROMPT " No Save "
DO curson
MENU TO nxchoice
```

Wayne C. Thomas
Marshfield, Massachusetts

Normally, KEYBOARDing an oddball character like 250 would be ignored, since no choice in the MENU TO or ACHOICE will start with CHR(250).

However, these procedures make Key 250 issue a SET CURSOR ON instruction. By KEYBOARDing it, this CURSOR ON command gets issued inside the MENU TO—not in front of it—so the cursor continues to remain visible.

- **CLIPPER CURSOR CONTROL: Turn the cursor on inside the MENU TO function with these short procedures.**
- **THE CROSSTAB VIEW: Get a close-up look at your data with *Reflex*'s CrossTab View.**
- **A SCREEN-CONTROLLABLE WAIT: This Clipper UDF combines the best features of WAIT and INKEY().**

Notice the NEXTKEY() line. It's purpose is to prevent the program from discarding any existing keystrokes in the buffer.

There's nothing magic about CHR(250)—any number above 128 will work.

THE CROSSTAB VIEW

I need to buy a database, and a friend recommended I buy *Reflex* because of its cross-tabulation feature, among other things. How does *Reflex*'s CrossTab view differ from the tally feature found in some other programs?

Fred Silverstein
Brooklyn, New York

I hope you read this column in the previous issue, where I discussed flat-file databases and used *Reflex* as an example. However, that article didn't cover the CrossTab feature.

To *tally* a field usually means to produce a list of all the unique values that a field takes, along with the number of times it takes that value. *Reflex*'s CrossTab feature is like a tally on two fields at once, using a row-and-column grid with all the values of one field heading the rows and all the values of the other heading the columns. At the intersection of a row and column, you find the number of records that match the field value in the row header *and* the field value in the column header.

Reflex's CrossTab feature is also more versatile than a two-way tally. A count of matching records is only one way you can analyze any nontext field. You can also find the smallest and largest value in a field using the summary functions @MIN and @MAX; total and average the values in a field using @SUM and @AVG; and calculate the variance and standard deviation using @VAR and @STD.

Once you've calculated the result, CrossTab gives you two ways to break down this information. The For Each option creates rows and columns for all the values taken by a given field. So, for example, if you want to know the total number of cars you sell each month, For Each could create a row for "total number" and 12 columns for each month of the year. Furthermore, using the Make Ranges option, you can create ranges of values for a numeric field; for example, 1 through 10, 11 through 20, and so on. This would be handy if you also wish to know how many cars you sell in different price ranges; say between $10,000 and $13,000, $13,001 and $16,000, and so forth.

CrossTab is also flexible in that rows and columns can hold user-defined conditions. You could enter

```
CityLine='.. CA ..' AND Salary >
  $50,000
```

which will display, in the CityLine row (or column), all those who live in California and have a salary greater than $50,000.

CrossTab also provides a shortcut to the Filter feature; select one cell in the CrossTab and apply a filter to the database that shows only the records that correspond to that cell. For example, if you want to take a closer look at all buyers who

purchased a car during December, highlight the cell at the intersection of that row and column and select Xtab/Filter from the menu. *Reflex* shows how many people bought cars with four-wheel drive.

But this is not to say you need to use all these features. You can perform a simple tally by filling in only the rows or only the columns in the CrossTab view.

Let's look at a CrossTab view of the sample CARS database shown in Figure 1. There are two fields: one for the state the car owner lives in and one for the car he drives. (There could be many more fields, but since just two fields can be cross-tabulated simultaneously, only two are shown.)

Suppose you wish to know if there's any correlation between the two fields' data. Just bring up the CrossTab view and fill it in. Choose @COUNT for your summary function and CAR for the field. Select CAR for the rows and STATE for the columns. The display now breaks down the count of your records by car and state. To see how each State/Car cell differs from the average, select XTab/Local Properties and choose to display as Index. This replaces the actual numbers with the percent difference from average.

Suppose there is also a field called INCOME, which contains the yearly income of each person. You could then see the average income for the people in each state who drive each car. Change the Field slot to Income, change the Summary function to @AVG and there you have it. The CrossTab view now shows the average income. Besides the information in each cell, this view also shows you the average income of people driving each car (the totals at the end of each row) and the average income of the people in each state (the totals at the bottom of each column).

A SCREEN-CONTROLLABLE WAIT

Clipper has two methods of waiting for a single keystroke from the user: WAIT and INKEY(). But each has a disadvantage.

WAIT has the drawback of moving the prompt down to the next line. Even if you specify a null prompt ("""), the cursor is left flashing on the left margin—often an unattractive or misleading place. And if you carelessly specify the command while your cursor is on line 24, the screen will scroll. INKEY(), on the other hand, allows cursor positioning, but the SET KEY procedures do not work (including the help key, F1).

The WAITKEY function (Figure 2) is the best of both worlds. The syntax is

```
<memvar> = WAITKEY(<row>,
<col>[,<message>])
```

Like INKEY(), WAITKEY prints your (optional) *message* at the specified screen coordinates and waits for a key to be pressed. Like WAIT, the SET KEY procedures perform normally.

Michael Magan
Rotterdam, The Netherlands

PC MAGAZINE

WAITKEY() actually does issue the WAIT command, but before the WAIT is issued, a key (in this case, the Enter key) is redefined with the SET KEY TO procedure command, and then this special keystroke is pushed into the keyboard buffer.

WAITKEY — COMPLETE LISTING

```
FUNCTION waitkey
PRIV row,col,message,key_in
PARA row,col,message
message=IF(PCOUNT()=3,message,"")
@ row,col SAY message
SET KEY 13 TO waitkey_1
KEYBOARD CHR(13)
IF ROW()=24
  @ 1,0 SAY ""
ENDI
WAIT "" TO key_in
RETURN key_in

PROCEDURE waitkey_1
SET KEY 13 TO
@ row,col+LEN(message) SAY ""
&& reposition cursor
RETURN
```

Figure 2: A *Clipper* UDF that allows screen positioning of the WAIT command.

Since WAIT is a *wait state*, the keyboard buffer is read and the special keystroke invokes PROCEDURE waitkey_1 immediately. But this keystroke (and its procedure) doesn't complete the WAIT—it only positions the cursor and resets the special key to its standard value.

The Enter key was chosen as the special key because it is usually not redefined with the SET KEY TO command. However, any other convenient key may be used.

CORRECTION

In the June 12, 1990, issue, the response to Steve Freides *FoxBASE* tip indicated that if all the application's procedures are incorporated at the end of the main program, *FoxBASE* will process them correctly without invoking SET PROCEDURE. This is true for *FoxPro*, but it isn't in fact true for *FoxBASE*. In addition, a line of code was dropped from the last insert of Freides letter. It should have read:

```
prgname = SYS(16)
SET PROCEDURE TO &prgname
RELEASE prgname
```

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Research for this article was provided by Brad Stark, a frequent contributor to PC Magazine, *and by Neil J. Rubenking, a contributing editor of* PC Magazine.

Figure 1: The CrossTab view lets you see what the relationship is between two sets of data.

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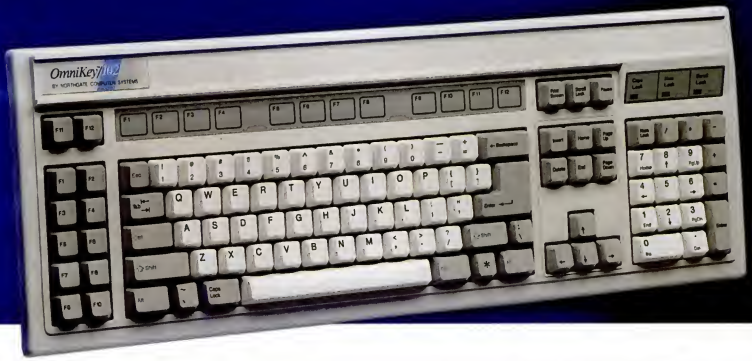

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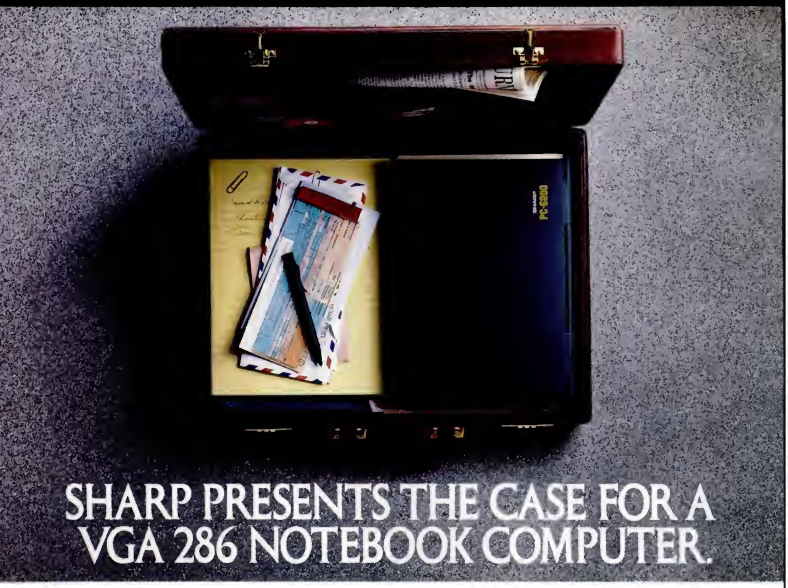
CIRCLE 293 ON READER SERVICE CARD



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by
Craig Stinson

Spreadsheets

SHARING MACROS

I recently took the plunge and switched from *Lotus 1-2-3* to *Quattro Pro*. On the whole, I'm highly satisfied, making happy discoveries almost daily. But I have wreaked havoc a couple of times by invoking *1-2-3* macros without first implementing the *1-2-3* menu tree. In any case, I prefer working with *Quattro Pro*'s own menus and find it a nuisance to switch trees when I want to run a macro. So I developed the macro subroutines 123_MENU and ORIG_MENU, both shown in Figure 1. When placed before and after an imported *1-2-3* macro, these routines ensure that the import will run correctly, regardless of what menu is in place.

The 123_MENU routine checks to see what menu tree is currently installed; it then switches to the *1-2-3* menu tree unless that tree is already installed. 123_MENU also checks to see if it is being called from within *1-2-3* itself; this way, files that use these routines can be swapped back and forth between users of both spreadsheet programs.

After the macro is run, the ORIG_MENU routine reinstates the menu tree that was originally in effect.

In order to make this system work, I had to modify the name of one of *Quattro Pro*'s three built-in menu trees. The options—QUATTRO.MU, 123.MU, and Q1.MU—are stored in disk files of the same

- **SHARING MACROS: Two short subroutines let you use your *1-2-3* macros under any *Quattro Pro* menu tree.**
- **FIND THE MEDIAN VALUE IN *1-2-3*: A simple macro adds @MEDIAN to your pool of functions.**

names. And because two of the menu-tree options start with Q, it is difficult to select a menu tree from within a macro. The macro can't even use cursor moves to select a menu tree, because the position of the options can vary from system to system, depending on the order of the MU files in the DOS directory!

To solve this problem, I changed the name of one menu-tree file from Q1.MU to OLDQUAT.MU (because the Q1 menu tree is designed to mimic the menu tree of the original *Quattro* spreadsheet program). But if you never need to use the Q1 menu tree, you can also solve the problem by simply deleting Q1.MU from your hard disk; you'll pick up about 200K of hard disk space with this second approach.

Ralph Sterling
Scranton, Pennsylvania

If you have always used *Quattro Pro* with the *1-2-3* menu tree, you will never need Mr. Sterling's admirable subroutines. But the more you use *Quattro Pro*, the more likely you are to adopt its native menu system. After all, Borland's manuals assume you're using the *Quattro Pro* menus; your colleagues are likely to be using them; and the advanced features of *Quattro Pro* are more logically placed within the *Quattro Pro* menus than they are on the *1-2-3* tree.

The problem is that you can't use the *Quattro Pro* menu tree when running macros developed for the Lotus spreadsheet. However, this problem disappears if you attach Mr. Sterling's subroutines to the front and back of your *1-2-3* macros.

The first line of the 123_MENU routine checks to see whether your macro is being run in *1-2-3* (the program, not the menu tree) or *Quattro Pro*. To do this, it takes advantage of the difference between the two programs' base date (the starting point from which date values are calculated). In *1-2-3*, the function @MONTH(1) returns 1, because the system's base date is January 1, 1900; while in *Quattro Pro* the same function returns 12, because the base date is December 31, 1899. So if the macro is run from within *1-2-3*, the first line of 123_MENU generates an immediate {return}, passing control back to the calling macro.

TREE-SWITCHING MACRO — **COMPLETE LISTING**

```
123_MENU   {if @month(1)=1}{return}
           {if @curvalue("startup","menus")="123.MU"}{return}
           {if @curvalue("startup","menus")="QUATTRO.MU"}{/ block;align}c123_menu~{/ startup;menus}1{return}
           {/ block;align}r123_menu~{/ startup;menus}1


ORIG_MENU  {if @month(1)=1}{return}
           {if @cell("prefix",123_menu)=="'"}{return}
           {if @cell("prefix",123_menu)=="^"}{/ startup;menus}Q{/ block;align}l123_menu~{return}
           {/ startup;menus}O{/ block;align}l123_menu~
```

Figure 1: These subroutines can ease the transition between *1-2-3* and *Quattro Pro*. 123_MENU determines what menus are currently in use and then installs the *1-2-3* menu tree. ORIG_MENU restores the menu tree that was previously in use.

The second line uses an {if} command and *Quattro Pro*'s @CURVALUE function to determine whether the *1-2-3* menu tree is currently installed. If it is, the 123_MENU subroutine has no further work to do, so it again returns control to the calling macro.

If the *1-2-3* menu tree is not in use, control passes to the third line, which again uses {if} and @CURVALUE—this time to see whether the *Quattro Pro* menu tree is being used. If it is, the subroutine does two things. First, it changes the label alignment of the cell named 123_MENU (the first cell in this subroutine) from left to center. This change will tell the ORIG_MENU subroutine that it needs to restore the *Quattro Pro* menu tree. Second, it changes the menu tree from *Quattro Pro* to *1-2-3*. Having done all this, it returns control to the calling macro.

So far, 123_MENU has checked for the *1-2-3* program, the *1-2-3* menu tree, and the *Quattro Pro* menu tree. If all three {if} commands produce false results, the only remaining possibility is that the old *Quattro* menu tree is being used. Therefore, the last line in 123_MENU applies right alignment to the cell named 123_MENU (a marker that will tell ORIG_MENU to restore OLDQUAT.MU) and installs the *1-2-3* menu tree. Control then passes to the calling macro.

When the calling macro has finished its business, it hands control over to ORIG_MENU, which, like 123_MENU, begins by determining which program is being used. If *1-2-3* is being used, ORIG_MENU bails out with a {return} command. If *Quattro Pro* is being used, the subroutine continues.

The remaining statements in ORIG_MENU check the alignment prefix used by the cell named 123_MENU. If the prefix is an apostrophe, the cell is left-aligned and the original menu tree has to have been *1-2-3*. Having no further work to do, the subroutine terminates with its second line.

If the prefix is a caret, the cell is center aligned and the original menu tree has to have been *Quattro Pro*. The subroutine reinstalls the *Quattro Pro* menu tree, switches 123_MENU's alignment back to left, and quits.

If the prefix is neither an apostrophe nor a caret, 123_MENU must be right-aligned and the original menu tree must have been OLDQUAT. The subroutine restores OLDQUAT and resets the alignment to left. And that's all he wrote.

Take these subroutines along if you're emigrating to *Quattro Pro*. They'll make the trip that much more enjoyable.

FIND THE MEDIAN VALUE IN 1-2-3

The mean is the most widely used—and often most useful—statistical measure of the true value of a range of numbers. But sometimes life presents us with a group of measurements that has one or two values well away from the others, so we have immediate reason to distrust the mean.

> **Thanks to its machine-language sorting, *Lotus 1-2-3* can speedily execute a macro that determines the median value in a range of numbers.**

The optimal solution is to get more data. But if this isn't possible and you still have to come up with your best guess for the true answer, it can be helpful to find the median value. At least it tells us which measurement is in the middle of the pack.

Unfortunately, *1-2-3* does not have an @MEDIAN function in its bag of tricks. Figure 2 lists a macro that remedies this deficiency. To run it, put the cursor in the cell where you want the median to appear, press Alt-M, then type in the range of numbers you want to evaluate. The macro uses BY1..BZ100 as a scratch-pad area. If you already have data there, you'll need to modify the macro to create a new work area. Also, if you need to evaluate more than 100 numbers, extend the range BZ1..BZ100 appropriately.

Geoffrey E. Dolbear
Diamond Bar, California

Thanks to *1-2-3*'s machine-language sorting, this macro is extremely quick. If you want to make the macro slightly more compact, you can put the statements

```
/rv~~
```

and

```
/reBY1..BZ100~
```

into a separate CLEANUP routine, then branch to that routine at the end of ODD and EVEN. As long as CLEANUP is followed by a blank line, you can also omit the {quit} instruction.

HINTS, TIPS, QUESTIONS

Share your latest spreadsheet discovery through *PC Magazine*'s Spreadsheets. We'll pay you $50 for anything we print. Please submit your letter on a disk, together with a printout. Mail your contributions to Spreadsheets, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column). ■

@MEDIAN MACRO — COMPLETE LISTING

```
     A          B
1    \M         {getlabel "Enter Range of Values ",TARGET}
2               /C
3    TARGET
4               ~BZ1~
5               /dsdBZ1..BZ100~pBZ1~d~g~
6               {let BY1,@COUNT(BZ1..BZ100)}
7               {if @MOD(BY1,2)=0}{branch EVEN}
8    ODD        {let BY2,@.5*BY1+@.5}
9               @INDEX(BZ1..BZ100,0,+BY2-1)~
10              /rv~~
11              /reBY1..BZ100~
12              {quit}
13   EVEN       {let BY2,@.5*BY1}
14              @AVG(@INDEX(BZ1..BZ100,0,+BY2-1),@INDEX(BZ1..BZ100,0,BY2))~
15              /rv~~
16              /reBY1..BZ100~
17              {quit}
```

Figure 2: This *1-2-3* macro finds the median of a range of numbers.

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CIRCLE 102 ON READER SERVICE CARD

by
Craig L. Stark

The Working Word

Since publishing a macro for putting "Page *x* of *y*" into *WordPerfect* 5.1 headers (May 15, 1990), my desk has been positively awash in reader responses suggesting alternatives for Version 5.0, and even one for *Microsoft Word* 5.0. The first macro corrects a minor if annoying anomaly that may occur with the original macro.

TOO MANY PAGES

Jordan Hodgson's page-numbering macro does enable you to use the "Page 1 of 5" form. However, it determines the final page of the document before it sets up the header. In some cases this may lead to a header that reads "Page 6 of 5" on the final page!

This bug occurs because *WordPerfect* places the header below the page margin, so adding a header pushes all text down. In a long document—even a single document if filled to the last line—this may force an additional page. If you reverse the order of operations in the macro (as shown in Figure 1), the header space is allocated in the document before the final page is calculated, and this eliminates the problem. As Mr. Hodgson suggested, you must use a unique place marker in the header and rely on the search-and-replace routine to put the correct final page number in the header.

Raymond J. Dale
Elkhart, Indiana

PC MAGAZINE While Mr. Dale addresses one potential problem in Hodgson's macro, he leaves another unsolved. At least as shown, both Hodgson and Dale macros create a new header that automatically overwrites additional header formatting information that you may want preserved. Dale, like Hodgson, uses the {SYSTEM} variable, so the macro can be used only in *WordPerfect* 5.1. But not everyone has upgraded, and users of *WordPerfect* 5.0 have a similar need, of course. To meet it, a large number of readers submitted a nearly identical solution.

- **TOO MANY PAGES: Eliminating the extra page when creating a page-numbering header in *WordPerfect* 5.1.**
- **MACROLESS PAGE HEADERS: Adding "Page *x* of *y*" page headers in *WordPerfect* 5.0.**
- **"PAGE *x* of *y*" IN WORD: Bookmark references provide a similar solution in *Microsoft Word* 5.0.**
- **FONTS ON THE FLY: Here's a use you never thought of for the *WordPerfect* 5.1 Equation Editor.**

MACROLESS PAGE HEADERS

The PAGEOFX.WPM macro (May 15, 1990) shows ingenuity and a strong command of *WordPerfect* 5.1's macro language to create a header with the "Page *x* of *y*" format, but there is another way to get the job done. The program's Cross Reference feature, which works in *WordPerfect* 5.0 and 5.1, lets you create the header, and at the same time eliminates the need to use a macro at all.

To implement the procedure, go to the last page of your document and press Alt-5 to bring up the Mark Text menu. Select R for Reference, T for Target. The program will prompt you for a target name; use *lastpage*. Once you've set up a target, go to the header or footer where you want to insert "Page *x* of *y*". Set up a constant text and variable page number by typing

```
Page ^B of
```

Then once again press Alt-5 to bring up the Mark Text menu and R to select Reference. Press R for Reference again and P for page number as the reference type. Finally, *WordPerfect* displays the most recently defined target name as the default.

After completing the document, you simply Generate it by typing the keystroke sequence

```
<Alt-F5>GGY
```

At this point the number of the page on which the "lastpage" reference appears will be inserted in the header where you marked the reference.

Michael D. Allie
Rochester Hills, Michigan

ALTP.WPM — **COMPLETE LISTING**

```
{DISPLAY OFF}
{Home}{Home}{Up}{Format}2312
{Flush Right}Page {^B} of @^^@
{Exit}{Exit}
{Home}{Home}{Down}
{ASSIGN}1~{SYSTEM}page~~
{Home}{Home}{Home}{Up}
{Home}{Replace}n@^^@{Search}{VAR 1}{Search}
{Exit}
{;}Create header for page number~
{;}Put marker in header~
{;}Return to document~
{;}Move to last page~
{;}Assign final page # to variable 1~
{;}Move to top of document~
{;}Put page count in header in place of marker~
```

Figure 1: An improved "Page *x* of *y* pages" header macro for *WordPerfect* 5.1 that does not create an extra page at the end of long documents.

The Working Word

My apologies that we can only pay one reader for the suggestion of several of you! This "macroless" procedure has definite advantages. As one reader pointed out, if you forget to generate your document before printing, you'll get a reminder prompt on the screen. Furthermore, this process solves the problem of header overwrite found in the Dale and Hodgson macros.

To round out the picture, here's a solution for users of *Microsoft Word* 5.0

"PAGE x of y" IN WORD

The bookmark feature introduced in Version 5.0 of *Microsoft Word* can be used for a wide variety of tasks; and since the page number of the bookmark can be referenced, it becomes easy to automate text insertion such as "See Section 4.7 on page 35." It is this option that allows you to put a "Page *x* of *y*" message in your header or footer.

The procedure is fairly simple. First, move to the end of your document and insert a paragraph such as "The End." Then Select the paragraph and turn it into Hidden text (Alt-X-E). Use the Format Bookmark command and give the *bookmark* a descriptive name, such as "endofdoc." In your running header, type

```
Page page[F3] of page:endofdoc[F3]
```

pressing F3 at the [F3]. This will appear on the screen as

```
Page (page) of (page:endofdoc)
```

At print time, the (page) macro will be automatically replaced on each page with the current page number, and the (page:endofdoc) macro will be given the number of the page—the last page—on which the bookmark appears.

Because bookmarks are stored with text, you can put this setup in a boilerplate document file or glossary entry.

David C. Hill
Phillips Ranch, California

The great amount of reader interest in this topic prompts me again to suggest that both WordPerfect and Microsoft incorporate an internal final page reference function into the next releases of their programs. It's absurd to make users go to such cumbersome lengths to implement a numbering system that—to say nothing of its other uses—is required by every law office that uses these programs. No doubt I'm a biased witness, but instead of waiting until I've finished a document, going to the bottom of it to hide references and then going back to the header to pick them up, I find it a more productive use of time simply to put *XyWrite*'s terse

> *WordPerfect's* Equation Editor isn't just for scientific writing. It also lets you incorporate fonts of any point size into documents without downloading them.

```
Page «PN» of «FP» pages
```

in my headers at the beginning. This will perform the same function in a single step.

FONTS ON THE FLY

In *WordPerfect* 5.1 you can incorporate fonts of any point size into documents, without downloading special fonts; simply use the equation editor. The procedure is as follows:

- Press Graphics (Alt-F9) and select Equation (6).
- Select Create (1) and then Edit (9) to bring up the equations editor.
- Press Options Display (Shift-F1).
- Set the options to (1) Print as Graphics, (2) Graphical Font Size (in points) desired, (3) Horizontal Alignment to Center, and (4) Vertical Alignment to Center.
- Return to the Equation Editor (F7).
- Enter FUNC {Headline} or other text, as explained below, and then return to the normal editing screen (press F7 twice).

Normally, WP's equation editor prints in italics, but by preceding the text with the word FUNC, a normal roman font will be used. If the text to be printed in graphics involves more than one word, surround the entire text with a pair of curved braces, as shown above. Spaces between words must be entered by hitting the Tilde (~), not the Spacebar. Note further that certain words, such as IN, OR, and NOT are *keywords* that are reserved by the editor; in order to print them you must precede them with a Backslash.

Marshall Cates
Los Angeles, California

Unless you're involved in scientific writing, the Equation Editor that was added in Version 5.1 of *WordPerfect* has probably meant little in your life. But it could mean much more if you want to print headlines in font sizes larger than you could normally produce with your laser or dot matrix printer.

Mr. Cates supplied samples of 130-point roman and italic printed on his HP LaserJet Series II, and of 100-point type produced by an Epson LQ850 dot matrix. My own experimentation with the technique (on a LaserJet II) shows that it certainly does work. One additional caution I would add is that you must have the desired type family (Times Roman, Helvetica, and so on) selected when you enter the equation editor. You can change the default point size by using the options menu, but you can't change the type family at that juncture.

In the course of experimenting with this font-generating technique, you'll also want to explore the symbol set options and other choices outlined in the discussion of the Equation Editor in the *WordPerfect Reference Manual*. The fonts generated in this way may not be *quite* as good as if they were created directly from the Bitstream Font Outlines, but neither do they take up a megabyte of disk space for a few letters in a size you may need only very occasionally. Mr. Cates gets my nomination for this year's C. P. Snow Award for bridging the gap between the two cultures of science and the humanities!

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by
Neil J. Rubenking

User-to-User

ONE COMMAND, MULTIPLE ACTIONS

The format of the current path in the environment is compatible for use in a FOR batch file command. If you use the path environment variable as the parameter list in a FOR command, you'll execute the command once for each directory on your path. As a simple example,

```
FOR %%D IN (%PATH%) DO DIR %%D
```

will display the contents of every directory on your path.

An extension to this technique is shown in EXECUTE.BAT in Figure 1. It checks for the existence of a file in every directory on your path and executes the first copy it finds. The advantage to using this batch file is that no "Bad command or file name" message will be displayed if the command isn't found. An example of its use might be EXECUTE MOUSE.COM.

Note the %%D.\%1—it is necessary to append a trailing backslash after the directory names, but it still works if a root directory (which already has this backslash) is on the path.

Scott Bussinger
Tacoma, Washington

- **ONE COMMAND, MULTIPLE ACTIONS:** Parse your path and perform actions in each of its directories.
- **USING THE XCOPY COMMAND:** This versatile command is one of the best reasons to upgrade.

The FOR command substitutes each path directory in turn into the variable %%D, and the IF statement tests for the existence of FOO.COM in that particular directory.

EXECUTE.BAT — COMPLETE LISTING

```
@ECHO OFF
REM EXECUTE.BAT
SET EX=
FOR %%D IN (%PATH%) DO IF (%EX%)==() IF EXIST %%D.\%1 SET EX=%%D.\%1
%EX%
SET EX=
```

Figure 1: When you pass any program name to EXECUTE.BAT, it searches the path and executes the first copy of the file that it finds.

The period after the FOR loop variable %%D in EXECUTE.BAT is quite important. To see why, let's consider how EXECUTE.BAT would work without it. Suppose that the command-line parameter is FOO.COM and that the path is C:\DOS;C:\. Using the first element, the sought-after filename is C:\DOS\FOO.COM, which is a perfectly valid filename. But using the second element, it's C:\\FOO.COM. This isn't a valid pathname, so even if FOO.COM does exist in C:\, the batch file won't find it.

Now suppose we use a period before the backslash. The first element gets translated into C:\DOS.\FOO.COM, which is fine. The second becomes C:\.\FOO.COM. In any directory, the double period (..) denotes the parent directory and the single period (.) refers to the directory itself. C:\.\ is the same as C:\, so the IF EXISTS test successfully finds files in the root directory. As long as none of the directories on your path have extensions, EXECUTE.BAT works.

Of course, DOS can already do what EXECUTE.BAT does—whenever you run a program that's not in the current directory, DOS searches the path. But what if you want to search the path for a data file? I used the techniques above to create ONPATH.BAT in Figure 2, which locates a given filename anywhere on your path.

ONPATH.BAT searches the path in the same manner as EXECUTE.BAT, except that when it finds the filename it simply echoes it. This works perfectly for unambiguous filenames (that is, those with no wildcards). When you give it a wildcard filename, its action is less satisfactory. Suppose you enter ONPATH *.COM. The result will be a single ECHO line for each path directory that contains at least one COM file: C:\DOS*.COM, for example.

The most obvious solution would be to simply replace the ECHO with another

ONPATH.BAT — COMPLETE LISTING

```
@ECHO OFF
REM ONPATH.BAT finds a file anywhere on your path.
IF "%1"="" GOTO NoParams
FOR %%f IN (%PATH%) DO IF EXIST %%f.\%1 ECHO %%f.\%1
GOTO End
:NoParams
ECHO This batch file finds a given filename
ECHO wherever it may appear on your path.
ECHO Syntax: "%0 FILENAME.EXT" (no wildcards)
:End
```

Figure 2: ONPATH.BAT locates *any* file, as long as it's on your path.

ONPATH2.BAT — **COMPLETE LISTING**

```
@ECHO OFF
REM ONPATH2.BAT finds files anywhere on your path.
IF "%1"==="" GOTO NoParams
REM IF using DOS less than 3.3, replace "CALL" with
REM "COMMAND /C" in the following line.
FOR %%f IN (%PATH%) DO IF EXIST %%f.\%1 CALL ONPATH3 %%f.\%1
GOTO End
:NoParams
ECHO This batch file finds a given file specification
ECHO wherever it may appear on your path.
ECHO Syntax: "%0 filespec" (may use wildcards)
:End
```

Figure 3: ONPATH2.BAT will find *all* files matching a template anywhere on your path.

FOR command such as

```
... FOR %%g IN %%f.\%1 DO ECHO %%g
```

However, DOS doesn't allow nested FOR loops. We need a second batch file to contain the second FOR loop. ONPATH2.BAT in Figure 3 uses ONPATH3.BAT in Figure 4 to list out the individual files matching a wildcard file specification. ONPATH2 *.COM will actually give you a list of all of the COM files that are on your path.

The reason you can parse the path this way is that DOS interprets the semicolon as a delimiter. If you wished, you could separate the parameters of a batch file with semicolons rather than spaces. That suggests another way to perform a set of commands on each element of the path using two batch files, such as A.BAT and B.BAT. A.BAT would contain only the lines

```
@ECHO OFF
B %PATH%
```

Batch file B uses the SHIFT command to process each command-line parameter in turn, and each is one of the path elements. A simple example might be

```
@ECHO OFF
:LOOP
IF "%1"==="" GOTO End
ECHO %1
SHIFT
GOTO LOOP
:End
```

This pair of batch files merely echoes each directory on the path, but you could easily do more-complicated things with it.

ONPATH3.BAT — **COMPLETE LISTING**

```
@ECHO OFF
FOR %%f IN (%1) DO ECHO %%f
```

Figure 4: Since DOS doesn't allow nested FOR loops, ONPATH2.BAT uses this short batch file.

USING THE XCOPY COMMAND

Copying files to a RAM disk and then to the destination disk (see "Copy floppies faster using an intermediary RAM disk," February 14, 1989) will indeed speed up the process of copying files by minimizing the head start-up time on the disk drives, but there are some disadvantages. For one, you must have a RAM disk large enough to hold all the files, and many users can't afford a huge amount of RAM. Besides, dedicating up to 1.44MB (the largest floppy disk size) of memory just for copying files seems like an incredible waste of memory. And even if you use a batch file, it is still inconvenient.

There really is no need to use a RAM disk, since DOS 3.2 and later versions contain a program called XCOPY.

XCOPY copies as much as possible at once, using all the available RAM as a buffer, while a RAM disk is limited to the size you give it at installation. It can copy more files than will actually fit in memory. If you are copying from one disk to another in the same drive, you'll have to switch disks a few more times. But with the RAM disk method, you wouldn't be able to do the copy at all!

XCOPY does not need to save the files temporarily. With a RAM disk, the files must be written to the RAM disk and later read back to copy them onto the destination disk. Instead, XCOPY stores each file in a buffer until it is written to the destination disk. Eliminating the need to write the files and reread them before copying increases throughput.

Lastly, you can use a single command to do the copying. For those of us who have yet to master batch programming, this is indeed a relief!

XCOPY first appeared in DOS 3.2. If you don't already have DOS 3.2 or later, you should consider upgrading.

Charles Hannum
Henryville, Pennsylvania

The XCOPY command is incredibly useful. Besides copying files much faster than the COPY command, it offers a number of new options. With XCOPY, you can choose to copy only files created after a certain date, or only files whose archive bit is set. You can copy an entire subdirectory structure and you can tell XCOPY to verify the results.

By combining XCOPY with ATTRIB, you can copy a hard disk subdirectory with many files onto as many floppy disks as it takes. First, set the archive bit on all the files with the command

```
ATTRIB +A *.*
```

Now give the command

```
XCOPY *.* A: /M
```

XCOPY will copy as many files as it can to the disk in A:, and the /M switch tells it to turn off the archive bit of each file it copies. When the disk fills up, XCOPY will stop with a "Disk Full" error. Just insert another disk and give the command again—XCOPY won't reuse the files it already copied, because their archive bits are now turned off.

There are still some virtues to copying via an intermediate RAM disk. For instance you could use it to make multiple copies of the source floppy. In this case, using XCOPY to load the RAM disk and make the copies will give you the best of both worlds. And if you use *PC Magazine*'s XPANDISK variable-size RAM disk, you won't have to waste RAM for the RAM disk when you're not using it.

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by
Jeff Prosise

Tutor

THE DOS PARTITIONING SCHEME

Can you shed some light on the MS-DOS partitioning scheme and how it works? What's the difference between a primary DOS partition and an extended DOS partition? And why can't you install more than one primary partition on a hard disk?

Bob Mattes
Edwards, California

■ THE DOS PARTITIONING SCHEME: Here's how MS-DOS divides your hard disk.

Partitioning is a means of dividing a single hard disk into several logical devices. DOS treats separate partitions on a hard disk as if they were separate hard disks. Having a 60MB hard disk with two 30MB partitions is the same as having two 30MB hard disks. You see them as drives C: and D:; DOS takes care of the details associated with accessing them as such.

Partitioning was originally developed so that different operating systems could share the same hard disk. The MS-DOS partitioning scheme permits a hard disk to be divided into as many as four partitions. Prior to Version 3.3, only one of these partitions could be used by DOS. Version 3.3 eliminated this restriction with the introduction of the extended DOS partition, which is a collection of logical volumes grouped together in a linked list format. Embedded within each volume is the address of the next volume in the chain. These volumes are treated just like normal disk partitions, even to the extent that they can be formatted with any DOS or OS/2-compatible file system.

The key to the MS-DOS partitioning scheme lies in the partition table FDISK sets up in the first physical sector of a hard disk. The partition table is a 64-byte structure that defines where the partitions are located on a hard disk, which one is bootable, and what file system each one was formatted with.

Figure 1 shows the format of the partition table, stored at offset 1BEh in the first sector on head 00h, cylinder 00h. It contains four 16-byte entries—one for each of four possible partitions. The first byte in each entry indicates whether or not the corresponding partition is bootable. If it's bootable, it should contain the bootstrap code needed to get the PC up and running. For bootable partitions, FDISK writes the value 80h to this slot; for others, it writes 00h. Only primary partitions can be designated as bootable. When FDISK marks a DOS partition as such, it scans the rest of the partition table and zeros any boot indicators it finds that aren't already zeroed, ensuring that DOS is the operating system that receives control at start-up.

The bytes at offsets 01h through 03h and 05h through 07h define the physical limits of the partition. The first three designate the starting head, sector, and cylinder numbers, and the second three the ending head, sector, and cylinder numbers. The sector number is only a 6-bit value. The extra bits aren't wasted, though; the upper 2 bits in the sector field are joined with the byte in the cylinder field to form a 10-bit cylinder number.

The byte at offset 04h, known as the system indicator byte, specifies what type

THE MS-DOS PARTITION TABLE FORMAT

	00h	01h	02h	03h	04h	05h	06h	07h	08h-0Bh	0Ch-0Fh
01BEh	B	H	S	C	I	H	S	C	RelSec	NumSec
01CEh	B	H	S	C	I	H	S	C	RelSec	NumSec
01DEh	B	H	S	C	I	H	S	C	RelSec	NumSec
01EEh	B	H	S	C	I	H	S	C	RelSec	NumSec

Field definitions

Offset	Symbol	Meaning
00h	B	Boot indicator (1 byte) 00h = not bootable 80h = bootable
01h	H	Starting head number (1 byte)
02h	S	Starting sector number (6 bits)
03h	C	Starting cylinder number (10 bits*)
04h	I	System indicator (1 byte) 00h = unused 01h = 12-bit FAT 04h = 16-bit FAT 05h = extended partition 06h = 32-bit FAT 07h = OS/2 HPFS
05h	H	Ending head number (1 byte)
06h	S	Ending sector number (6 bits)
07h	C	Ending cylinder number (10 bits*)
08h	RelSec	Number of preceding sectors (4 bytes)
0Ch	NumSec	Length of partition in sectors (4 bytes)

* Formed by adding the upper 2 bits of the previous byte to the 8 bits of the current byte. The extra bits become bits 8 and 9.

Figure 1: The partition table, located in the first sector of hard disks prepared with DOS or OS/2, defines the physical location of up to four partitions, what file system each was formatted for, and which partition is bootable.

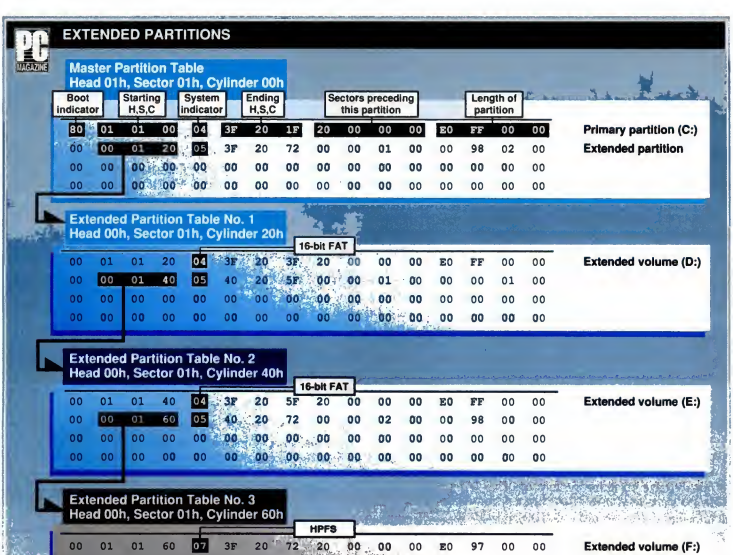

Figure 2: The chain of partition table entries for a 120MB hard disk divided into one primary partition and one extended partition. The extended partition contains three logical volumes. The final volume is formatted for OS/2's High Performance File System.

of file system the partition was formatted for. A value of 00h means the partition is unused. A 01h identifies a DOS partition that uses 12-bit FAT (file allocation table) entries, while a 04h identifies a DOS partition that uses 16-bit FAT entries. An extended DOS partition is marked with the value 05h. A 06h indicates that the corresponding partition is a huge (greater than 32MB) partition set up by DOS 4.0 or OS/2. And 07h is the value assigned to partitions formatted with OS/2's HPFS (High Performance File System).

The key to the MS-DOS partition scheme is the 64-byte structure set up by FDISK.

What happens if you install an operating system that mistakenly uses one of these reserved values to identify its own partition? Fortunately, this doesn't happen often, because most vendors of PC-based operating systems are aware of DOS's conventions and steer clear. But when it does, havoc can result. At least one version of Xenix I've seen writes an ID value of 06h to the partition table. If you're running DOS 3.*x* or earlier, you're okay—DOS will recognize that it's somebody else's partition. But DOS 4.0 and OS/2 will think it's a huge partition with 32-bit FAT entries. Attempting to access it could result in damaged data. The last thing you want to do is to run CHKDSK on it.

The last two fields in the partition table entry, at offsets 08h and 0Ch, are doubleword entries that hold the starting sector

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number relative to the first sector of the disk and the total length of the partition in sectors, respectively. Although these values are somewhat redundant (DOS could easily calculate them based on other values in the partition table) having them stored in this form is helpful because it eliminates some of the work involved in accessing the partition.

During start-up, DOS scans the partition table for partitions formatted with DOS-compatible file systems and assigns logical drive letters on a first-come, first-served basis. In most versions of DOS, partition table entries are read from front to back, so the entry at offset 1BEh becomes drive C:, the entry at 1CEh becomes drive D:, and so on. Some DOS resellers, however, tweak the code to read entries from back to front. In this case, the partition whose entry appears at offset 1EEh becomes drive C:, the one at 1DEh becomes drive D:, and so on. If there is more than one hard disk, DOS assigns drive letters to primary DOS partitions before allocating room for extended partitions.

The entry for a primary DOS partition is a straightforward one. The partition corresponds to one logical volume. DOS assigns a drive letter to it at start-up. Its characteristics are spelled out in black and white in the partition table, and locating it on-disk is a simple matter of consulting the partition table to find out what head, sector, and cylinder it starts on.

Utilizing extended partitions enables DOS 3.3 users to make more-efficient use of their hard disks by allowing them to bypass the four-partition limit found in the MS-DOS primary partitioning scheme.

PARTABLE.SCR — **COMPLETE LISTING**

```
A
MOV  AX,0201          ;Function 02H
MOV  CX,0001          ;Cylinder 00H, sector 01H
MOV  DX,0080          ;Head 00H, drive 80H
MOV  BX,0200          ;ES:BX -> CS:0200
PUSH CS
POP  ES
INT  13               ;Read the sector
RET                   ;Exit

G
D 03BE 03FD
Q
```

Figure 3: This short DEBUG script reads the first sector of a hard disk. The instruction D03BE displays the master partition table. Be sure to type in the code exactly as it is shown; a miscue could render your hard disk unreadable.

Extended partitions are set up a little differently. Each partition can hold several logical volumes known as extended volumes. Each extended volume carries with it its own extended partition table (whose format is identical to that of the master partition table stored in the first sector of the hard disk), and inside each partition table, masquerading as yet another extended partition, is the address of the next extended volume in the chain.

Figure 2 shows the chain of partition table entries for a 120MB hard disk formatted with a primary DOS partition and an extended DOS partition. Actually, the names are somewhat misleading: the primary "DOS" partition in this case is used exclusively for OS/2. A better way to describe these partitions would be as a primary 16-bit FAT partition and an extended partition.

The disk's master partition table contains two entries. The first defines the primary DOS partition, which starts at head 01h, sector 01h, cylinder 00h and ends at head 3Fh, sector 20h, cylinder 1Fh—a total of 65,504 sectors, or 32.8MB. The extended partition spans the range from head 00h, sector 01h, cylinder 20h, to head 3Fh, sector 20h, cylinder 72h, consuming almost 85MB worth of storage space.

Finding the first extended volume in the extended partition requires that we read the starting sector spelled out for the extended partition in the master partition table and decipher the extended partition table stored there. The first extended volume is a type 04h that is 65,504 sectors in length. The second entry describes another extended partition, which contains a second extended volume identical to the first. Proceeding one level deeper yields the final extended volume, a 19MB type 07h formatted for OS/2's HPFS.

I hope the picture is becoming clearer. Extended partitions neatly circumvent the limit of four partitions imposed by the size of the master partition table. They do this by chaining together as many logical volumes as a disk will hold. FDISK limits you to one primary DOS partition, because extended partitions are the preferred mechanism for installing multiple DOS partitions. Had DOS 3.3 users been restricted to primary partitions, they would also have been limited to 120MB per hard disk—far too little to enable DOS to make efficient use of large hard disks.

If you're curious to see what the master partition table on your hard drive looks like, you can use the short DEBUG script shown in Figure 3 to view it. The script actually has you assemble a short machine code program that uses the BIOS Read Sector service to read the hard disk's first physical sector. Once the contents of the sector have been read into memory, the instruction D 03BE displays the partition table. Be very careful to type in the script exactly as it is shown, especially the line MOV AX,0201; a miscue could render the hard disk unreadable.

ASK THE TUTOR

The Tutor solves practical problems and explains techniques for using your hardware and software more productively. Questions about DOS and systems in general are answered. To have your questions answered here, write to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column). We're sorry, but we cannot answer questions individually. ■

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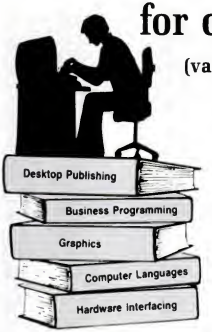

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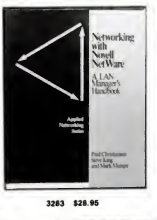

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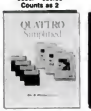

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Connectivity

IRQs AND I/O ADDRESSES

Please explain the configuration of LAN cards, especially IRQs and I/O addresses. This seems to be a big secret among our local suppliers, and they aren't willing to show us the how-to of installing network client stations.

Gary Johnson
Rockford, Illinois

Some people might consider the techniques they use to avoid interrupt and memory address conflicts trade secrets, but they aren't hard to learn. Check Figure 1 for a list of interrupts and memory locations normally used in XT- and AT-class PCs.

The best advice is first to try the defaults recommended by the manufacturer of the adapter. Presumably, the company chose these defaults to avoid known problems, so don't immediately assume you know better. At the same time, you should be aware that the COM2 serial port on all PCs uses IRQ3. Most PCs use electrical techniques that avoid a conflict if the port is not addressed. This means you usually can use an adapter at IRQ3, even if there's a COM2 in the machine, as long as you don't try to use the COM2 serial port and the network at the same time—as you might, for example, with a serially attached printer or modem.

Many companies provide either a software or hardware method to disable an onboard COM2 port. A smart LAN administrator asks how to disable COM2 whenever a new machine comes into the office. Getting this information early can save problems later.

Because so many AT clones come equipped with an internal COM2, installers often use IRQ5 when they put LAN adapters in these computers. But don't try this setting in a PC XT—the XT's hard disk controller will conflict with IRQ5 every time!

IRQ2 is another good bet on AT type machines. However, this IRQ is used to multiplex requests to IRQs 8 through 15, so you might encounter some troublesome conflicts if any devices in the AT use these higher-numbered interrupt channels. IRQ2 conflicts often sneak up on you when you later add an internal device to a computer that has been happily operating with a LAN adapter at IRQ2.

- **IRQs AND I/O ADDRESSES: Understanding how IRQs and memory locations are normally used helps avoid conflicts.**
- **BUILDING A LAN: Consider current needs and future growth when choosing a network.**
- **USING ARTISOFT CARDS WITH ELS NETWARE: Artisoft's new Ethernet card can be used with Novell's *ELS Netware*.**
- **MOVING AWAY FROM MICROVAX: Replacing a minicomputer with a LAN.**

You'll have to set an I/O address for the general operation of the board and perhaps for a special autoboot PROM. Many adapters use I/O addresses at 2A0h and 300h with good success. Autoboot ROMS let you use diskless workstations to boot from the server. These ROMs use higher addresses, and they sometimes conflict with the ROMs in modern video adapters. We've used CC00h as the ROM boot address in many VGA systems with good luck.

Not all LAN adapters use DMA channels. The 3Com EtherLink II, for example, does use DMA, but the Gateway G/Ethernet does not. If your adapter uses DMA, then try DMA3 as the default on an AT style machine. On an XT, slip down to DMA2 to avoid conflicting with the XT's hard disk.

If you use the defaults, you usually won't have a problem setting up a LAN adapter in a typical client workstation. However, the challenge comes when you want to install a LAN adapter in a PC equipped with an SDLC (sychronous data link control) adapter for a mainframe connection or with a tape drive controller. These devices and, to a lesser extent, inter-

COMMONLY USED IRQ AND MEMORY ADDRESSES

IRQ	Memory address	Device
2	-	Use with care in an AT
3	2F8h	COM2
3	2E0h	COM4
4	3F8h	COM1
4	2E8h	COM3
5	280h	Tape controller
5	3F0h	XT hard disk controller
5	278h	LPT2
6	3F0h	Floppy disk controller
7	378h	LPT1

Figure 1: These IRQ addresses and memory locations commonly interfere with the operation of LAN adapters. Try the LAN adapter with the default settings first. If they don't work, then look for other unused combinations.

nal mouse adapters will often default to the same IRQ and memory locations used by LAN adapters. When this happens, one of the conflicting products must move, usually to IRQ5, with an I/O address of 320h in an AT.

Getting multiple boards to work together in tricky installations is often a matter of experience and luck. That's why many system integrators only support product lines that they know work together. The craft of LAN installation has some art, but it is primarily a skill, using specific rules and a roadmap of the PC's architecture.

BUILDING A LAN

My client wants to run 35 workstations from a single server. The stations will run applications written in *Clipper*, such as order entry and accounts receivable. Some stations will be busy all the time with heavy data entry, while others will enter data at a slower pace. The rest of the stations will run reports and do inquiries.

They'll probably add word processing and spreadsheets later on, but that's not the main purpose of the network. Speed is a priority.

Can you give me a few tips on how to set up the network?

Eliezer Biderman
(via CompuServe)

PC MAGAZINE The network you describe is only slightly more robust than today's average PC-based network. You didn't mention printing, but if you have general ledger applications, then printing reports will be another big network burden. Before you settle on your LAN file server hardware and software, though, you should determine how much growth you expect the system to undergo.

If network activity will remain at this level for a couple of years, you could use a good DOS-based LAN operating system like *LANtastic* or *D-Link* on your server. Set up separate PCs as the print servers and the file servers. Put all of the accounting data files on one server with a couple of megabytes of RAM for a cache and a large, fast hard disk drive. Use another file server for other application files and give users with heavy printing tasks their own attached printers. Judicious juggling of resources will let you support this level of LAN activity with DOS-based servers.

However, if you expect your network to grow soon, you should consider server software based on a true multitasking operating system. Novell's *NetWare* is popular and well supported; 3Com's *3+Open* is a good implementation of the Microsoft *LAN Manager* program; Banyan's *VINES* has unique features for big networks; and Performance Technology's *PowerServe* is easy to install and economical. Find a dealer you trust and then choose the operating system based on what the dealer supports. Use a server that has a 20-MHz 386 processor, 4MB to 5MB of RAM, and an ESDI drive with a seek time of 18 milliseconds or quicker.

Select IEEE 802.3 Ethernet or ARCnet adapters for the LAN. Don't spend the money for Token-Ring and don't even consider adapters that don't meet Ethernet or ARCnet standards.

USING ARTISOFT CARDS WITH ELS NETWARE

I recently purchased Artisoft's *LANtastic* network and am very satisfied with the system—particularly with its frugal memory requirements. Now I find that I must use Novell's *ELS* software for a program I'm installing. Can I continue to use Artisoft's NetBIOS with the Artisoft boards under Novell *ELS NetWare*, and if so, how?

Howard B. Perer
Ft. Lauderdale, Florida

PC MAGAZINE You didn't specify whether you use Artisoft's 2-megabit-per-second adapter or the new Ethernet card. You can use the less-expensive 2Mb adapter under standard versions of *NetWare* by generating a *NetWare* shell using the NetBIOS driver from *NetWare*'s SHGEN program menu. Unfortunately, *ELS NetWare* doesn't include this option, so there's no easy way to use the Artisoft 2Mb adapters under this software.

The new Artisoft Ethernet board is a clone of the Novell NE-2000 Ethernet adapter. If this is the card you're using, you can generate a shell for an NE-2000 in any version of *NetWare* and use it on the Artisoft Ethernet adapter. One thing to note, though: the Artisoft adapter can carry up to 64K of on-board RAM, while the NE-2000 uses a maximum of 16K. If you've added optional memory to the Artisoft board, you'll need to change jumpers to reduce the amount of active memory. If you use the Artisoft adapter as it came out of the box, don't worry about changing any jumpers.

MOVING AWAY FROM MICROVAX

I'm the chief fiscal officer of a small county. We currently use a DEC MicroVax II with over 500MB of hard disk storage. We process about 12,000 checks annually from accounts payable, another 10,000 payroll checks, and we maintain assessment records for 25,000 parcels of land. We are growing at between 5 and 6 percent per year.

Will a PC-based network be able to replace our MicroVax?

Kevin Pyle
Millersburg, Ohio

PC MAGAZINE Yes, unequivocally yes. Because you're a fiscal manager, you should be concerned with two areas in particular: the capability of the networked accounting software you select, and the security of your data. Many accounting software packages available for PC-based LANs have features and flexibility that equal or exceed those of minicomputer-based software. This means that you'll have the pleasant task of choosing between several excellent LAN-based accounting programs.

On the network side, however, you'll need to place special emphasis on backup, restoral, and security capabilities. LAN-based systems are often more casual in their approach to backup and security than minicomputer systems. Instead of being integrated into the system as it is in minicomputers, LAN backup is a third-party add-on option. Many LAN operating systems lack the detailed security features of minicomputer operating systems. You might also have to consider better physical security for the LAN server than you do for the MicroVAX.

Write tight specifications for security and backup, but on the whole, rest assured that a LAN and the LAN-based accounting software will carry the workload of your county for years to come.

NETWORK YOUR QUESTIONS

Connectivity gives you practical solutions to networking problems of all types. We'll pay $50 for any tips we print. Please submit your letter on a disk and be sure to include a printout. Then mail your contributions to Connectivity, *PC Magazine*, One Park Avenue, New York, NY 10016, or you may contact Frank J. Derfler, Jr., via MCI Mail (be sure to use Derfler's box named PC MAGAZINE LAN LABS). Unfortunately, we are unable to answer letters on an individual basis. ■

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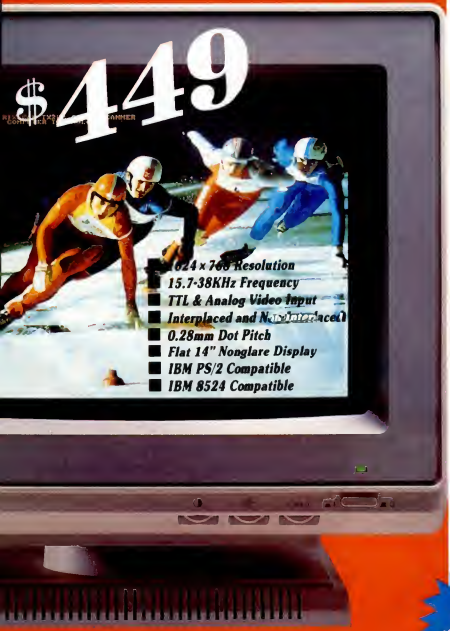

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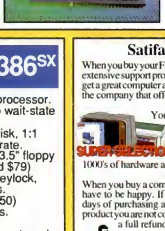

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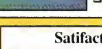

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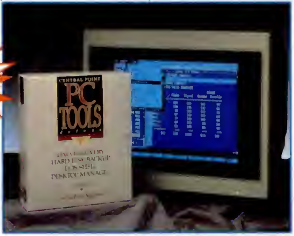

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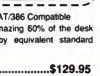

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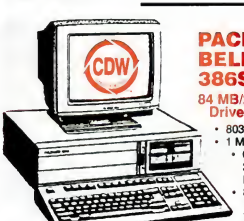

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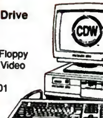

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June 27, 1989

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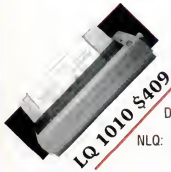

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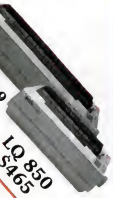

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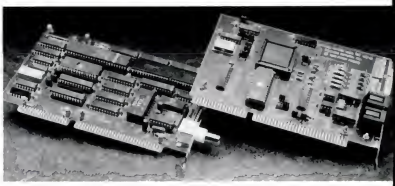

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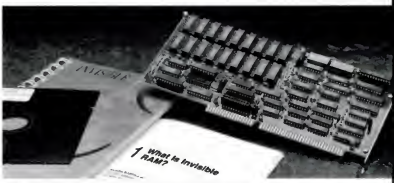

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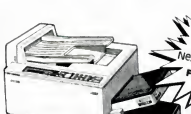

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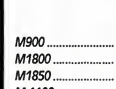

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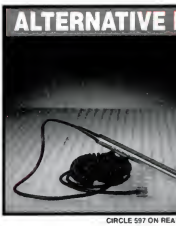

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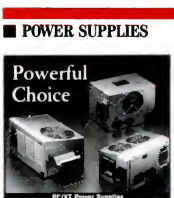

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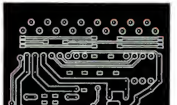

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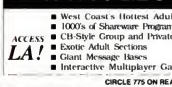

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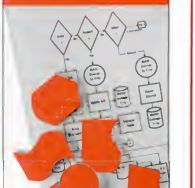

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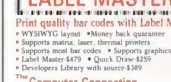

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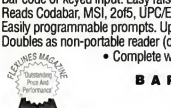

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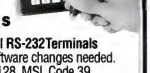

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COMING UP

PC MAGAZINE

■ **EVERYTHING YOU WANTED TO KNOW ABOUT PC SERVICE AND RELIABILITY***

(*...and were glad we asked!)

For the past ten years, *PC Magazine*'s most important mission has been to provide our readers with the most complete and up-to-date comparative information available on PCs and peripherals. In keeping with that mission, our next issue will be devoted to the results of a survey included in the March 29, 1990, issue of *PC Magazine*. We've used that survey to compile the first comprehensive analysis of your many and varied experiences with PCs and peripherals.

And it was those experiences that our survey data illuminated most clearly. We asked you to tell us about those clunkers that went *kaput* right out of the box, about those that died little by little, and about workhorse systems and parts that keep on chugging along year after year.

We wanted to know how you were treated by manufacturers and service organizations. We asked whether or not you'd buy from the same folks again. Nineteen tough questions about these and other aspects of your equipment zeroed in on six specific hardware categories: CPUs, monitors, graphics boards, hard disk drives, printers, and laptops.

Judging from the thousands of responses we received in the ensuing weeks, you had plenty to say—and you minced no words about your preferences, your satisfaction, or your lack thereof.

Coming up next issue, our survey respondents get their chance in the spotlight. Not only will we rank the manufacturer and equipment you rated, we'll use your comments to highlight and expand upon our analysis of which companies get a place in the PC Hall of Fame and which are relegated to the Hall of Shame. And we'll talk to those very companies to hear what they have to say about it.

Want to know who's best and who's worst? Stay tuned! ■

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After Hours

Products for the Leisure Side of Personal Computing

Bible Study Software Allows Comparison of Different Translations

BIBLE SOFTWARE
by Don Trivette

"Ask and it will be given to you; seek and you will find; knock and the door will be open to you." If you weren't quite sure where in the Bible to seek this text (from Matthew 7:7), you could find it by using one of the many Bible study software packages currently available for the PC, including *MegaWord Gold* *Edition* from Paraclete Software ($124.95), *CompuBible* from NASSCO ($99), or *PC Study Bible* from BibleSoft ($139.95).

MegaWord's menus are activated by tapping the Alt key and the first letter of one of five main menu choices: Search, Environment, Clipboard, Dictionary, and Notes. You press Alt-S, for example, to pop up the Search menu and then highlight one of the menu choices, like New Search or Display Text. New Search is a text-sensitive way to find all the verses that contain certain words, while Display Text is used to find a particular book, chapter, or verse.

The Search command supports various types of searches, including case sensitive (god or God), sequence specific (Adam... and...Eve), and exact phrases (In the beginning). In addition, you can limit the scope of a search to verse, paragraph, chapter, or book. *MegaWord* goes beyond similar software in its ability to add notes and annotations to any word in the text. Most computer Bible programs allow you to attach notes only to verses.

Although *MegaWord* has a windowing feature which displays two Bible versions on-screen simultaneously (each additional version costs $50), this facility is not as easy to use as it should be. You cannot switch between an active window (the King James Version, for example) and an inactive window (New International) by simply pressing a swap key. Instead you must go through a series of commands to deactivate the current window and activate another one. Nor can you split a single Bible version into two windows so you can compare verses side by side.

CompuBible, though, does windows and does them well. The screen can be divided into two, three, or four windows, each containing a different version of the Bible or each containing different books and verses of the same version. The program comes with your choice of translation, and additional versions are $79 each. With different versions—the King James and the New International for example—the windows can be locked together so that you can scroll simultaneously through verses and compare text. The interface is simple and elegant.

CompuBible's menu structure is similar to that of *MegaWord*, except it uses the Shift key instead of the Alt key in conjunction with the first letter of a command. The Verse command retrieves a known book, chapter, and verse while the Index command searches for specific words. The Verse command has an unusual "range" feature that groups certain books together. You might select the Old Testament, the New Testament, the Pentateuch, the Psalms of David, the Twelve Prophets and several other ranges, or you could define your own range. Once the range is set it applies to all searches until it is reset.

Rather than a notepad feature, *CompuBible* offers a separate program, called *Reference Bible Window*, which comes on the same distribution disk. *RBW* can be installed as a TSR, and lets you paste Bible verses into the

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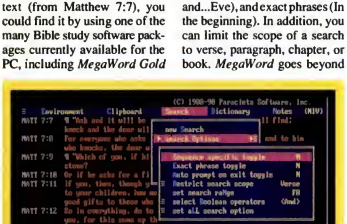
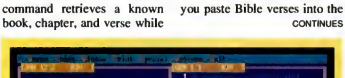


MegaWord's search options can be set to perform case sensitive, sequence specific, and exact phrase searches.

■ GAMES
Bandit Kings Of Ancient China: **adventure in an exotic time and place.**

LHX Attack Chopper **simulates the cutting edge in copter design.**



CompuBible supports up to four windows, each of which can show text from a different version of the Bible.

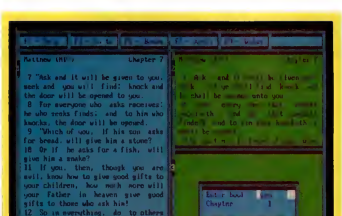
Study Bible

CONTINUED

reports and letters you create with your favorite word processing program.

PC Study Bible uses both function keys and first-letter commands to navigate through its biblical waters. "C," for example, brings up the concordance window from which you can search for any key words or phrases. "V" pops up a window in which you can request the text of any book, chapter, or verse. The W command opens a new window in which you can display another verse or even another Bible version. Moreover, like *CompuBible*, *Study Bible* allows you to jump from window to window with a single keystroke, but it limits the screen to a maximum of three windows, (which is about all you can meaningfully use, anyway).

Searches are performed from the concordance window; the software has a variety of wildcard and case-sensitive options so you can zero in on a particular word or phrase. The concordance window has an easy-to-use word finder which is intended to help you find words you don't quite know how to spell. You simply append a "+" to the letters you do know. Unfortunately, proper nouns are not included in the dictionary, so typing me+, if you are looking for Methuselah, produces a list of words like men, meat, and measure which you probably already know how to spell.



PC Study Bible **comes with three versions of the Bible and it can display text from all three at the same time.**

Study Bible's greatest asset is that it comes with three Bible versions: The King James, the New International, and the American Standard. Three additional versions—the Revised Standard, the Living, and the New King James—are available for $49.95 each. A $99.95 Greek-Hebrew Dictionary is another option.

All three programs are good research tools for Bible study. *CompuBible* seems to be slightly faster, and it has a more polished user interface than the other two, although the lack of an integrated notepad might be a problem for some scholars. The three Bible versions included in *PC Study Bible* make it the one to buy for those interested in comparative study.

List Price: *MegaWord Gold Edition*, $124.95. $50 for each additional Bible version. Greek or Hebrew dictionary, $75 each. **Requires:** 512K RAM, hard drive, DOS 2.1 or later. Paraclete Software Inc. 1000 E. 14th St., #425, Plano, TX 75074-4010; (800) 825-6342.

CIRCLE 396 ON READER SERVICE CARD

List Price: *CompuBible*, $99. $79 for each additional Bible version. **Requires:** 384K RAM, DOS 2.1 or later; hard drive recommended. NASSCO Inc. P.O. Box 65600-222, Lubbock, TX 79464; (800) 288-2044, (806) 791-5138.

CIRCLE 397 ON READER SERVICE CARD

List Price: *PC Study Bible*, $139.95 (includes three Bible versions). Greek/Hebrew dictionary $99.95. Each additional Bible version $49.95. **Requires:** 256K RAM, DOS 2.0 or later. Hard drive recommended. BibleSoft, 22014 7th Ave., South Seattle, WA 98198; (206) 824-0547.

CIRCLE 398 ON READER SERVICE CARD

Fight For Control of Ancient China in Koei's Latest Role Playing Game

GAMES
by Barry Brenesal

Bandit Kings of Ancient China (BKAC) is fantasy role-playing software with a distinctly original twist. There are no goblin hordes to slay, and no insectoid aliens out to enslave humankind. Instead, you find yourself in the China of 1101 AD as one of ten larger-than-life bandit heroes. Your goal is to capture and execute Imperial Minister Gao Qiu.

He's seized the reins of power from the weak-willed emperor and gone on a campaign of looting, destruction, and subversion of ancient property values. You've got 27 years to nab your man, for in 1128 the Northern Mongols invade, and the Imperial Palace gets rezoned heavy commercial.

Unlike the average war game, *BKAC* and other Koei "oriental conqueror" simulations spend relatively little time on battle. Instead, these games focus your concerns on resource allocation. Should you build the taxable base of wealth in the province you control? Alternatively, should you emphasize food production? Buy weapons or ships? Draft more bandits? Negotiate alliances with your more powerful neighbors? Spy on them? The choices are many and varied, but the number of objectives you can accomplish at any given time, alas, is very limited.

To make matters even worse, you start out most *BKAC* scenarios as an exiled unknown, in search of a place to settle. No one respects you, and when you finally claim a province, you've got Gao Qiu to deal with. If his bullying chieftains aren't strong enough to invade, and can't threaten you into giving up funds, his agents sneak into your treasury and pilfer it.

Bandit Kings of Ancient China **is rendered in attractive EGA graphics; the game also supports high-resolution CGA monochrome.**

Your character's index of

CONTINUES

Bandit Kings

CONTINUED

three virtues (integrity, mercy, and courage) affects his relationships with visitors, rivals, and the populace. These values are preset, and no hero is extremely strong in all three categories. Different talents build different power bases.

The only help lies in the more than 100 other characters who wander through or rule the 49 provinces, each with a distinctive face, personality, and set of abilities. During play you fight some of these characters, form alliances with others, and bring as many as possible into your service. You try to win the most powerful people as close friends and associates, who may later perform valuable "turns" in your service.

While *BKAC* spends less time on actual conflict than many other games do, war is inevitable if you are to capture Gao Qiu. In previous games, Koei's approach to physical conflict had been abstract, rather like chess or checkers. Icons moved over hexagons with only a few conflict options.

BKAC's battles, however, offer more variables. Terrain shows seasonal changes and includes fast-moving rivers, wind shifts, daily weather variations, and tide strength. All of these conditions can have an influence on troop movement and army health. Each of *BKAC*'s 49 landscapes presents unique challenges and rewards different strategies.

One of the most open-ended role-playing games available, *BKAC* boasts four different scenarios, ten user-directed heroes to choose among, and five levels of computer difficulty. With all that rich variety, the likelihood of running across a repeated game in *BKAC* is infinitesimal. In addition, the computer plays all other characters, including the unused heroes, and never seems to allocate resources or people in identical fashion from game to game. This wealth of detail will please even jaded gamers.

Bandit Kings **places more emphasis on detailed combat than did earlier adventure titles from Koei.**

Besides the enhanced combat, there are some welcome refinements over previous Koei products. Personal configurations of message speed, sound, and animation are now saved to individual files and reloaded each time a specific game resumes. Disk protection has been removed. The lack of VGA on U.S. home computers has led Koei to reinvest in higher-resolution CGA black-and-white, after having abandoned it in *Genghis Khan*. The EGA graphics are less intense than in many other games, use more pastels, and cause little eyestrain. Details of line drawing are very attractive.

Note, too, that the program uses only 384K of memory, and relatively few files, which it accesses almost continuously—making this an excellent candidate for disk caching.

The manual includes vivid anecdotes about the 10 heroes and 37 of the other figures you will run across. This background material combines with more than 100 portraits and sets of personal statistics to imbue *BKAC*'s people with considerably more independent life than is found in your average computer characters.

BKAC is an addictive game, brought alive by a mixture of computer-driven personalities, the romance of a departed culture, a large battery of options, and the unpredictability of game play. So annoying are Gao Qiu's actions and remarks that you actually get a real sense of pleasure when he's captured and shortened by a foot—from the head, down. Of course your hero could suffer the same fate, but there's always another chance to save the realm.

List Price: *Bandit Kings Of Ancient China*, $59.95.

Requires: 384K RAM, DOS 2.0 or later, EGA/VGA. Koei Corp., 1 Bay Plaza, #540, 1350 Bayshore Hwy., Burlingame, CA 94010; (415) 348-0500.

CIRCLE 399 ON READER SERVICE CARD

New Electronic Arts Copter Simulation Tests Your Flight and Combat Skills

GAMES
by Tom Unger

After scoring successes at sea with *688 Attack Sub* and on land with *Abrams Battle Tank*, Electronic Arts completes the triad with its latest simulation, an airborne winner called *LHX Attack Chopper*.

LHX stands for *L*ight *H*elicopter e*X*perimental, a new family of combat 'copters that employ advanced materials and complex new computer-controlled avionics to improve their flight characteristics and make them less vulnerable to airborne and ground-based enemies. The LHX's existence anywhere but on the drawing board is unconfirmed, but if Electronic Arts' simulation is even remotely accurate, this is one super flying machine.

LHX Attack Chopper's excellent pilot's manual gives you a thorough primer in the fine—and often fatal—art of helicopter warfare. It explains basic characteristics of helodynamics—torque, rotational compensation, nap-of-the-earth flying, and other stuff you'll be too busy to worry about if you want to avoid a variety of bad guys without slam-

CONTINUES

While piloting the *LHX Attack Chopper*, you must concentrate not only on flying, but also on avoiding hostile fire.

LHX Attack

CONTINUED

ming your machine into the ground.

That said, it's comforting that the LHX does some of the flying for you; you needn't worry about real-world concerns like controlling the speed of the tail-fan. But staying airborne is far from a cakewalk. Because you fly close to the ground to avoid detection, you're constantly at the whim of friendly little air currents that cause abrupt changes in altitude, sometimes with unfortunate results.

You may use a mouse, your keyboard, or a joystick to steer your helicopter through three simulated battle areas: Libya, East Germany, or Southeast Asia. In any of these areas you can choose from about ten different mission types, in which you'll fire laser-guided machine cannons, Hellfire anti-tank missiles, and AIM-9L Sidewinder or Stinger air-to-air missiles at Soviet-made armaments. These range from relatively benign BTR-70 troop carriers to deadly Kamov Ka-34 Hokum attack helicopters and MiG-27 Flogger jet attack aircraft.

LHX gives you five levels of difficulty from which to choose. Level One is easiest, and Level Five is about as close to unsurvivable as it gets: enemies see you long before you see them and unless you're an expert pilot you'll be climbing out of your own personal smoking crater every time. This isn't to imply that *LHX* is impossible to play; on the contrary, after about 15 hours in the cockpit I found Level Three relatively easy, and Level Four a just-winnable challenge.

The LHX's cockpit is user-configurable to give you as much or as little information on its three CRT screens as you want. Should one screen crack when you're hit, you can reconfigure the other two. If you lose all your screens and your heads-up-display (HUD), you can use satellite views to attempt to make it home in one piece.

If you manage to land your crippled chopper in enemy territory, you may be lucky enough to garotte your guard, escape from your POW camp, and fly again. And if you're hit in the cockpit you may struggle to return your aircraft to base, but die of complications from your wounds. In any case, *LHX* informs you at the end of each mission how much damage your craft incurred, and how much of the taxpayers' money it will take to repair it.

Should you not wish to fly the world's most advanced rotor-driven aircraft, Electronic Arts has tossed in three other flying machines, including the venerable McDonnell Douglas AH-64A Apache attack helicopter (excellent when facing ground-based armor) and—for rescue missions, transport missions, and supply drops—the Sikorsky UH-60A Black Hawk.

Or, if you're truly adventurous, you might try the Bell/Boeing V-22 Osprey, a highly experimental, vertical takeoff and landing, tilt-rotor plane. But frankly, after flying the LHX, these other aircraft seemed downright clunky—like driving station wagons after airing out an Indy Car.

LHX supports the ADLIB card for realistic high-volume helicopter sound—though you'll be perfectly satisfied with what comes out of your PC's little speaker. Explosions sound like explosions, and machine-gun-fire sounds like machine-gun-fire. When your ship takes an incoming shot from a rifle or something larger, each shot produces a slightly sickening *thud* that lets you know you're that much closer to walking home.

LHX Attack Chopper's from-the-ground view lets you watch the action from a variety of unusual angles.

The orthogonal graphics are a little simple even in 256-color MCGA mode, but that's forgivable considering the pace and complexity of the animated action. Electronic Arts doesn't skimp on *LHX*'s user-controlled views—nearly a dozen perspectives in all. You can watch from behind your 'copter, from an airborne spotter craft or one on the ground, from the warhead you've just fired, from behind your target, or from the target itself. A satellite view gives you a rough approximation of your location should total instrument failure occur.

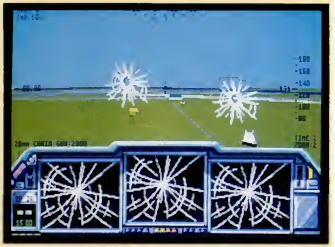
One vast improvement over Electronic Arts' previous military simulations is the amount of diversity *LHX* offers. In *Abrams Battle Tank*, for example, you know where the enemies are once you play through all of the missions, so success becomes more an element of memorization than of skill. In *LHX*, each mission is different—to a degree. Not only does the terrain vary somewhat from location to location, but there are three or four different scenarios for each mission. One Medevac mission may be entirely different from the next, and positions and types of enemies change from mission to mission.

To the diversity of missions add five playing levels, four aircraft from which to choose, and more than two-dozen enemies—several of them airborne (and therefore highly unpredictable), and most of them quite deadly. Given all that, it will take you some time to become bored with *LHX Attack Chopper*. In fact, it may take you several tries just to survive an entire mission.

LHX Attack Chopper exemplifies the current generation of highly detailed, extremely challenging military simulations. It should appeal to military hardware fans and hardcore gamers alike.

List Price: *LHX Attack Chopper*, $59.95. **Requires:** 512K RAM; CGA, EGA, MCGA 256-color; DOS 2.10 or later. Copy protected through documentation. Electronic Arts, P.O. Box 7578, San Mateo, CA 94404-7578; (415) 572-2787.

CIRCLE **400** ON READER SERVICE CARD



Flying your crippled LHX can become a deadly exercise in no-instrument frustration—one you're not likely to survive.

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PC MAGNET

CIRCLE 497 ON READER SERVICE CARD

by Bill Howard

Abort, Retry, Fail?

The Lighter Side of Personal Computing

Presto! Automatic Word-to-WordPerfect Translation with PC Tools

From a Central Point Software flier for *PC Tools*, Version 6:
"Locating the file you're looking for is faster and more convenient than ever, too. Just press the 'Locate' key and select the appropriate file type from the menu (for example, Microsoft Word Files). Then, at the prompt, enter some text you know is inside the file. Within moments, every Word file on your hard disk that includes the key words you've specified is displayed on the screen. Using PC Tools' dynamic viewing capability, you can browse through the list and spot the correct document in a matter of seconds. Once you've found the file, press 'Launch'and PC SHELL loads WordPerfect and the desired file, all, automatically."

Hard-disk distributor Liuski International Inc. will have a tough time keeping up with the competition if its sales reps vault their hurdles wearing football shoes rather than track cleats, as in this ad in *Reseller Management*, April 1990

NOTE Before you can use 1-2-3/G, it must be installed on your computer. Part No 36082

CARTOON: RICHARD TENNANT

If your entry is used in Abort, Retry, Fail? we'll send you $50 and a *PC Magazine* T-shirt. Caution: In case of multiple entries, the postmark date, neatness and completeness of entry are considered. Winners this issue: Raju Thadani (color monsier), Greg Gothard (100 MHz DRAMs), Dennis DeLorme (MCGA), Rochelle Theophano (*1-2-3/G*), Mike Judson (football cleats), Stephen Rindsberg (Word or *WordPerfect?*).

Helpful reference manual advice from Lotus on maximizing performance with *1-2-3/G*.

Mea Culpa

"With an aftermarket VGA display, you can buy one monitor and reasonably expect it to work with any computer and graphics adapter that you have, from CGA to VGA. (All VGA monitors automatically work with the Memory Controller Gate Array [MCGA] standard used by low-end PS/2 computers.)" *PC Magazine*, May 15, 1990 (MCGA actually stands for Multi Color Graphics Array.)

CLASSIFIED INTELLIGENCE

"Computer Equipment: XT-compatible, 2 disc drives, color monster, mouse printer, desk and software $1000 - Bass guitar + amp $275. XXX-XXX-XXXX"
—Classified ad, Yorktown Heights, NY, *Pennysaver*, March 28, 1990

AMA ING FACTS

"Dynamic RAM (DRAM) chips operating at 100 MHz are used in the 25-MHz systems currently being shipped by ALR, while 80-MHz chips will be used in the 33-MHz systems that ALR is now delivering in sample quantities."
—*Infoworld*, April 23, 1990

1. It's pretty obvious from the specs on the opposite page that the Dell™ 316SX will deliver the power you need for 32-bit computing. And it will do it for the kind of price you might expect to pay for a 286 machine. But there are some other things you might want to consider before you make up your mind.

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